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CERTAIN ASPECTS OF LACTATION PERFORMANCE IN SOWS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

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* * * * *

The Ohio State University
1960

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ACKNOWLEDGMENTS

I wish to express my sincere appreciation to my advisers and friends, Dr. Thomas M. Ludwick and Dr. Richard F. Wilson, Professors in the Department of Animal Science, Ohio State University. I am greatly indebted to Dr. Ludwick and Dr. Wilson for their inspiration, time, guidance and technical assistance in planning this project and editing the manuscript.

My sincere thanks are expressed to Dr. Wilson Pond of the Department of Animal Husbandry, Cornell University, Ithaca, New York, who gave me the original idea for this dissertation and who gave unsparingly of his time and effort in the early planning of this project.

To Dr. George Johnson, Chairman of the Department of Animal Science, Ohio State University, and Dr. Paul E. Smith of the Department of Agronomy, Ohio State University, I extend my thanks for their technical advice and editing of the manuscript.

My sincere thanks go to Dr. Theodor Heidhues of Gottinger, Germany, for translating the articles written in German which were used in this dissertation.

I wish to express my appreciations to Paul Knapp, student of Animal Husbandry at Cornell University, Ithaca, New York, Charles J. Sniffen, 4-H Club Agent, Columbia County, Hudson, New York, and Author Jordan, Swine Herdsman at Ohio State University, for their untiring and inspiring efforts in the collection of the data.

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INTRODUCTION

The major progress made in the breeding of farm livestock during the past half century has been due to progeny testing. Progeny testing has become more advanced in dairy cattle than in other classes of farm livestock because of the ease with which data may be collected and because of a single trait, namely milk production, which is of major economic importance.

In beef, sheep, and swine, progress in progeny testing has been rather slow because of the obstacles which arise when measuring their productive ability and because several factors including growth rate, feed efficiency and carcass quality are mutually important traits.

Swine rank high among the other classes of farm livestock in the speed with which they are able to produce a finished product. The rate of weight gain in pigs is very high and they often reach market weight in five months or slightly less. Suckling pigs will double their birth weight by the end of the first week of life and often triple it during the second week. These rapid gains made before weaning are due primarily to the milk producing ability of the sow.

Prolificacy and milking ability are essential for a successful swine operation. Progeny testing of sows should be thought of as a tool to measure both their prolificacy and direct nutritional influence on the litter. Prolificacy and milking ability are characteristics which should be considered by the breeder in the selection of his breeding stock.

Although prolificacy in swine is of primary importance, it must be associated with good nursing qualities of the sow; otherwise, its value from the economic standpoint will be considerably reduced. However, high milk producing ability alone if associated with low prolificacy may be equally disadvantageous.

After the pigs are weaned, their genes become increasingly more important for certain characters. Their performance for gain and body conformation then becomes more a measure of the transmitting ability of the sire and dam and less of the direct environmental influence from the sow.

There is apparently as much variation among individual sows as in cows in their ability to produce large amounts of milk. The milk production studies in swine are at about the same stage today as those of milk production in cows fifty years ago. This is because present day methods of measuring milk yield in sows are rather difficult and needs a great deal of experimental study.

Although the milk of a sow is not used directly for human purposes, it is none the less important in today's swine operation. The problems in this entire area are much beyond the parameter of a single research project, therefore, only several aspects have been outlined for study. A simple and accurate method of measuring the milk producing ability of a sow is needed. The primary objectives of this dissertation are to determine the positional effect of mammary glands and their milk yield.

REVIEW OF LITERATURE

A great deal of data have been accumulated on milk production in sows over a period of years. The majority of workers have used relatively small numbers of animals and have done their work under a wide variety of conditions. This review has been written to include studies on milk production in sows together with some of the factors thought to affect milk production.

Milk Production in the Sow

The ratio of weight gain to birth weight is greater in pigs than in the offspring of other domestic animals. Pigs more than double their birth weight by the end of the first week of life and often triple it at the end of the second week. The milk production of the sow plays a very important role in these rapid weight gains of pigs early in life (Allen et al. (1959).

There is apparently almost as much variation among individual sows as in cows in the ability to produce large amounts of milk. Smith (1952a) stated that studies of milk production in sows are at the same stage as those of milk production in cows fifty years ago. The reason given for this was that measurements of milk yields in sows are laborious and if done on a very extensive basis require much specialized equipment.

To date, research workers have studied the lactation curve of sows by weighing the pigs individually or as a litter before and after nursing

at predetermined intervals, the gain in weight being the weight of milk suckled. The first attempt to determine the milk production of sows was conducted by Gohren (1865). Since that time similar studies have been conducted. This process was repeated at intervals of seven days by Schneider (1934), Bonsma and Oosthuizen (1935), Smith (1952), Barber et al. (1955) and Allen et al. (1959) or at intervals of ten days by Hughes and Hart (1935). Weights were taken over an eight, twelve- or twenty-four-hour period, and the increase in weight was multiplied by the approximate time interval to give the total production.

Barber et al. (1955) used a nursing control period of twenty-four to forty-eight hours and found the milk production during the second twenty-four hour period to be much less because the technique of weighing and the diversion from natural conditions seemingly reduced the milk yield over an extended period of time.

The predetermined nursing interval during the experimental weighings has varied widely with investigators. Henry and Woll (1897) used a two-hour interval during the day and a four- to five-hour interval at night. Schneider (1934) used a two-hour interval during the first two weeks and a three-hour interval the third through the eighth week of lactation. Hughes and Hart (1935) used a two-hour interval early in lactation, four hours in the middle period and six hours at the latter end. Bonsma and Oosthuizen (1935) used an interval of two to three hours, while Donald (1937) used a two-hour interval during the day and a three-hour interval at night. Barber et al. (1955) and Smith (1952) used an interval of one to one and one-fourth hours and reported the largest yield of milk reported

to date. Allen et al. (1959) used a two-hour interval for an eight-hour control period.

The effects of prolonged nursing intervals from two to five hours were examined by Donald (1937) and he concluded that pigs nursing during a prolonged period obtained more milk. Olofsson and Larsson (1930) allowed pigs to nurse twenty-four times in twenty-four hours in the first week, in the second week nineteen times, and in the third week fifteen times a day. This technique of more frequent sampling showed a greater milk yield than was generally found by other workers.

Wells et al. (1940) stated that pigs nursing on a one-hour interval gave approximately one-third more milk than those on a two-hour frequency.

Several workers have studied the natural nursing frequency of pigs, and their results are summarized by Smith (1952a) in Table 1. In general, the nursing interval varies from 60 to 90 minutes, with the majority being 60 minutes in length. Shepperd (1927) observed that the nursing interval during the day was similar to that at night, while Smith (1952a) found the night nursing interval to be slightly but not significantly longer.

Table 1

Authority	Nursing Interval in Minutes ^{1/}	
	Early in Lactation	Late in Lactation
Vinogradsky (1939)	72	90
Schneider (1934)	60	90
Wells <u>et al.</u> (1940)	60	Variable
Shepperd (1927)	62	62
Smith (1952a)	60	75
Barber <u>et al.</u> (1955)	60	90

^{1/}Mostly by Smith (1952a)

The process of suckling by pigs has been described in detail by research workers. Hughes and Hart (1935) and Donald (1937a) reported that they observed three distinct stages in suckling by pigs. The first stage was a preliminary period during which individual pigs sought a teat and stimulated the flow of milk by massaging the udder. During this period many of the pigs ran around and touched the snout of the sow. Quite suddenly the second stage began during which the pigs suckled rapidly and did not massage. The third stage followed shortly and consisted usually of an extended amount of time of massaging the udder as in the first stage but included more actual suckling. All of the stages varied in length of time, but the third stage often lasted fifteen minutes.

The first stage in suckling is thought to yield no milk; the third stage yields only small amounts; while the bulk is obtained in the second period. Turner (1952) stated that during the first stage, the stimulus of nursing and massaging caused the discharge of the "let down" hormone from the posterior lobe of the pituitary gland. The milk is unavailable to the pigs until the contraction of the myo-epithelial cells surrounding the alveoli and ducts occurs and expells the milk.

Carlyle (1903) observed that the actual nursing time varied from one to two minutes with fully half of the time spent in getting the flow of milk started. Hughes and Hart (1935) observed that the pigs actually obtained milk for a period of sixty seconds, whereas Donald (1937) estimated this stage to vary between thirty-five and forty-five seconds.

Allen et al. (1959) studied the suckling preference of pigs as measured by the number of functional nipples at weaning on inbred

Landrace, Poland and Duroc sows and on Landrace X Poland crossbred sows during two consecutive lactations. The pigs showed a strong preference for the anterior teats. Little difference was noted in the preference of pigs for the first and second pectoral glands. The instances when the nipple pairs were functional at weaning, however, decreased rapidly from the second abdominal pair to the second inguinal pair where the latter was present. The larger pigs tended to suckle the anterior nipples whereas the smaller pigs suckled those which were more posterior.

Since 1865, when Gohren first made a test to determine the milk production of sows by weighing the pigs before and after nursing, similar studies have been made by other workers. Data relative to milk production by sows as reported by several workers are summarized in Table 2. The averages vary from 3.4 to 16.18 pounds per day in various experiments. Total milk production for the period of eight weeks has been found to vary from 401 to 701 pounds per sow.

Milk production varies in the sow during various periods of lactation. Henry and Woll (1897) reported that milk yield was small immediately after parturition but gradually increased with a maximum flow being reached about the fourth week of lactation. Most workers agree that the peak in milk production is reached at the third, fourth, or fifth week with a gradual decline thereafter (Carlyle, 1903; Davies, 1904; Schmidt and Lauprecht, 1926; Hempel, 1928; Olofsson and Larsson, 1930; Hughes and Hart, 1935; Albig, 1939; Filmer, 1950; Niwa et al., 1951; Greenslade, 1952; Smith, 1952a; Berge and Indreb, 1953; Lalevic, 1953;

TABLE 2

Milk Production of Sows^{1/}

No. of Lactations	Ave. No. of Pigs in Litter	Daily Milk Production Lbs.	Production During Lactation			Authority
			8 Wks. Duration Lbs.	10 Wks. Duration Lbs.	Other Duration Lbs.	
1		3.4				von Gohren (1865) ^{3/}
4	6.8	5.2		364.0		Henry & Woll (1897)
12	7.2	5.4			464.9 ^{2/}	Carlyle (1903)
1	7.0	5.6		389.2		Davies (1904)
3		11.4	638.4			Ostertag & Zuntz (1908)
1	9.0	10.2				Schmidt & Lauprecht (1926)
1	7.0	11.6				Schmidt & Lauprecht (1926)
1	9.0	7.2	404.9			Schmidt & Lauprecht (1926)
1	6.0	10.7	600.0			Schmidt & Lauprecht (1926)
1	8.0	8.2	460.5			Schmidt & Lauprecht (1926)
36	8.3	6.9	388.2			Schmidt & Lauprecht (1926)
4		6.9		481.0		Ohligmacher ^{3/}
7		6.5		457.7		Ohligmacher
2	7.5	7.7		539.0		Hughes & Hart (1935)
43		11.7				Wells, Beeson & Brady (1940)
22	8.57	7.1	401.0			Schneider (1934)
25	7.8	7.4				Borowsky & Kwasnitsky (1932)
4	8.5	10.34			508.5 ^{4/}	Olofsson & Larsson (1930)
22	8.8	7.35	411.6			Hempel (1928)
61	7.1	12.07	674.0			Smith (1952)
28	8.5	16.18	701.2			Berge & Indreb (1953)

^{1/} Smith (1952)^{2/} Twelve-week lactation^{3/} Quoted by Schmidt and Lauprecht (1926)^{4/} Seven-week lactation

Barber et al., 1955; and Allen et al. 1959). Individual sows vary in the time required to reach a peak in milk production whereas others seem to maintain an optimum level until the eighth week of lactation once they reach their peak.

Allen et al. (1959) stated that there was no significant relationship between weight of the sow at farrowing and the amount of milk produced.

Schneider (1934) found that sows fed a high protein diet produced more milk than those on a low protein ration, especially during the early part of lactation.

The reaching of the peak in milk production of sows between the third and fifth week of lactation would be in keeping with what is known about the nutrient requirements of baby pigs. As pigs are quite small during their first few days of life, their capacity to consume milk would be limited, but would increase as they grew larger with increasing age. During these first few weeks of life the pigs would be almost entirely dependent upon milk for their nutrients (Greenslade, 1952). After the peak in milk production is passed, the pigs are old enough and large enough to consume supplemental feeds and are not entirely dependent on milk for their source of nutrients.

Smith (1952) suggested that the control of the shape of the lactation curve by feeding or management could well result in control of the intake of supplementary feed by the litter. Smith (1952a) also found in a study of litter behavior that in the fifth to the seventh, and to some extent in the eighth week, the pigs will first suckle the sow and then go to the

creep for additional feed. After this they go to sleep until time for the next nursing. He concluded that the pigs eat the additional creep ration because they are not receiving a sufficient amount of milk from the sow rather than taking less milk because they are eating supplementary feed.

Allen et al. (1959) found there was a tendency for litters from sows which gave the most milk to consume the most creep feed.

There is a lack of agreement as to the milk yielding ability of individual teats. Schmidt and Lauprecht (1926), Shepperd (1927), Hempel (1928), Donald (1937a), and Barber et al. (1955) reported that the anterior teats produced more milk than the rear teats, although Racz (1931) reported that the third pair of teats from the front frequently gave most milk.

Wohlbier (1928) found that the amount of milk coming from different teats varied widely. He felt this variation was due largely to the constitution of the pigs, with the most vigorous pigs obtaining the most milk. The most vigorous pigs, he felt, evacuated the teat most completely, thus providing a favorable stimulus to the productive capacity of the gland. Weak pigs were unable to empty the teat and, therefore, gave little stimulus to production. After several days, the teats occupied by the vigorous pigs were clearly recognizable. In those teats not suckled, the milk production soon ceased.

The question has been pondered as to whether the heaviest pigs at birth take possession of the anterior teats instinctively, or whether it is a matter of chance as to which pigs suckle these teats and then

become the heaviest pigs in the litter because they get the most milk.

Of the three sows and litters studied by Barber et al. (1955) it was found that the heavier pigs in two of the litters took over the anterior teats, while the smaller pigs nursed the middle and posterior teats. However, with the third litter the procedure was reversed. The three lighter pigs in the litter took over the anterior teats while the heavier pigs suckled the more posterior teats. It was noted that the three lightest pigs were heaviest at the end of three weeks due to having received more milk.

Factors Which Affect the Milk Yield of Sows

Since the amount of milk produced by sows varies so widely, it is of interest to review some of the factors which may be responsible for this variation.

The influence of the number of lactations has been studied and has been shown to have a marked effect on milk yield. Data from various workers, summarized in Table 3, by Allen et al. (1959), indicate that the milk yield increases up to the third litter and possibly to the fifth or sixth. Milk yield has not been observed in the same sows, however, for more than three consecutive lactations.

A number of investigators have observed that the amount of milk which a sow produces is dependent upon the number of pigs she suckles

Schmidt and Lauprecht (1926), Olofsson and Larsson (1930), Hughes and Hart (1935), Wells et al. (1940), Kovacs (1954), Dschaparidse (1936), and Thompson (1931). Berge and Indreb (1953) reported that the average daily

Table 3

Influence of Age of Sow on Milk Yield^{1/}

Age When Yield Was Highest	Authority
Third to sixth lactations	Schmidt and Lauprecht (1926)
Third lactation ^{2/}	Dschaparidse (1936)
Third lactation ^{2/}	Smith (1952)
Third to sixth lactations	Wells, Beeson, and Brady (1940)
Third lactation	Berge and Indreb (1953)
Third lactation	Sambowsky (1932)

^{1/} Mostly by Allen et al. (1959)

^{2/} Yield measured for only three lactations

milk production of sows with small litters was 8.4 pounds whereas in sows with litters of 12 pigs it was 21.9 pounds. The average of 1.76 to 2.65 pounds of milk per pig per day was recorded with the pigs from the smaller litters receiving the larger amounts. Lalevic (1953) reported that the production of sows suckling six pigs was 295.3 pounds of milk while for those suckling fewer pigs it was 280.0 pounds during the entire lactation period. He found a positive correlation between the number of pigs per litter and the amount of milk produced by the sow.

Dschaparidse (1936) stated that the size of litter influenced milk production but that the increase was not in proportion to the size of the litter.

Allen et al. (1959) is in agreement with Dschaparidse and found that an average of 35.97 pounds of milk was produced per pig. The regression coefficient for milk production and litter size indicated values of approximately 18 pounds for each additional pig. Thus as the litters increased in size there was a smaller amount of milk produced per pig.

It was explained by the fact that the teats vary widely in the amount of milk they produced (Wohlbier, 1928 and Hempel, 1928), and when litters are small only the most productive nipples remain functional. As the litters increase in size some of the less productive nipples are functional. Another influencing factor could be that there is a physiological limit in the total amount of milk the sow can produce, and larger litters would mean that less milk could be produced per pig.

Breed differences in milk producing ability of sows have been indicated by some investigators. Where the breeds have been indicated they have been shown in Table 4 as summarized by Smith (1952a). Since different investigators have used different methods of measuring milk production and conditions have been quite variable between different experiments, it is not known how significant the differences between the breeds might be. In a few cases, however, where several breeds were used in the same study, breed differences did exist. It is recognized, too, that definite differences in milk production could exist between different strains within each breed.

Factors Dependent Upon Milk Yield of Sows

The gain in weight made by the pigs is greatly dependent upon the amount of milk produced by the sow. Zeller et al. (1937) stated that a sow's performance beyond the number of pigs farrowed may be thought of as a combination of a progeny test of the sow and a measure of her direct nutritional influence on her litter. As the pigs become older, their own genes become increasingly more important for a given character, and

TABLE 4
Milk Production by Breeds^{1/}

Authority	Breed	No. of Lactations	Litter Size	Ave. Daily Prod. Per Sow Lbs.	Ave. Total Production Per Sow Lbs.
Carlyle (1903)	Berkshire	4	7.7	6.31	354.3
Carlyle (1903)	Poland China	4	7.5	4.86	372.2
Carlyle (1903)	Razor Back	4	6.3	5.17	289.5
Schmidt and Lauprecht (1926)	Landschwein	26	8.3	6.9	388.2
Hempel (1928)	Landschwein	22		7.35	411.6
Schneider (1934)	Edelschwein	22	8.3	7.16	401.2
Olofsson and Larsson (1930)	Yorkshire	4	8.5	10.34 ^{2/}	508.53 ^{3/}
Bonsma and Oosthuizen (1935)	Large Black	52	6.67	6.55	366.7
Smith (1952)	Berkshire	15	7.4	14.4	808.0
Berge and Indreb (1953)	Landrace	27	8.44	16.18	701.20
Dechambre (1934)	Berkshire			6.30	449.39
Dechambre (1934)	Poland China			4.85	428.12
Dechambre (1934)	Yorkshire			4.65	
Allen et al. (1959)	Duroc	19	7.0		236.2
	Landrace	14	7.5		306.2
	Polands	9	6.0		265.9
	Landrace x Polands	8	8.8		299.9

^{1/} Mostly by Smith (1952a).

^{2/} Average for period between 2nd and 8th week.

^{3/} Total for 7 weeks.

their performance is more of a measure of the transmitting ability of the sow and less of her direct environmental influence.

Bonsma and Oosthuizen (1935) stated that although milk production is influenced by litter size, the milk yielding ability of a sow is not determined by litter size. Since prolificacy and milking ability are two separately inherited characteristics, they should be considered as such by the breeder in the selection of his breeding stock. While prolificacy is of primary importance, its value from an economic point of view, will be considerably reduced if it is not associated with good nursing qualities. On the other hand, high milk producing ability associated with low prolificacy is equally disadvantageous.

Berge and Indreb (1953) observed that the weight gain of the first three to four weeks was chiefly determined by the milk yield of the sow and that improved fertility in sows must be accompanied by a higher milk production or an earlier use of supplementary feed if the weight gains are to be maintained.

Barber et al. (1955) found a close positive relationship between milk intake and live weight gain of the pigs during the first three weeks of life. During the last five weeks of the lactation period when the pigs were fed a supplemental ration, this close relationship was not observed. It was suggested that the supply of sows milk was frequently insufficient to meet the pigs' requirements for optimum growth. Olofsson and Larson (1930) stated that eight weeks after farrowing the sow's milk supplied about 40 per cent of the total nutritive requirements of the litter and

suggested the danger of premature weaning.

Thompson (1931) found that lighter pigs at birth consumed less milk daily than pigs with heavier birth weights. In pigs of approximately the same birth weight, those receiving a greater supply of milk made greater gains during the suckling period and for the next 60 days following the suckling period.

Olofsson and Larsson (1930) stated that pigs from small litters were heavier at birth and made more rapid gains during the first weeks than those of larger litters, but after five weeks of age this difference in gain was insignificant.

Schneider (1934) also noted an appreciable difference in the total milk yield of sows with different litter sizes. In the grouping of twenty-two sows according to litter size, he obtained averages of 5.6, 8.2, and 10.5 pigs per litter with an average total milk production of 286.3, 359, and 512 pounds respectively. Each pig according to his respective litter size received 51, 42, and 49 pounds of milk. Wells et al. (1939) made a similar observation.

The gain in weight for the first four weeks of lactation for each ten pounds of milk was calculated for thirty-two litters by Hempel (1928) and was found to average 3.29 pounds. The variation between litters ranged from 2.42 to 5.48 pounds. This marked range in different litter requirements for each pound of gain was thought to be due more to the influence of environmental factors than to differences in the composition of the milk of the sows.

Berge and Indreb (1953) found that the amount of milk produced per

pig and the weight per pig were closely correlated. They found no correlation, however, between the size of the litter and weight gains per pound of milk. The coefficient of correlation between daily milk production and daily litter gain was found to be between 0.80 and 0.90.

Smith (1952) divided the eight week lactation period into two parts to show the total sow and litter intake of nutrients. He found that the sow required 3.9 feed units to produce the milk needed for one pound of weight gain per pig in the first period and 2.7 feed units during the second period. He assumed that the sows were equally efficient over the two periods and suggested that the increased efficiency of the pigs in the second four week period was due to the fact that they ate more supplementary feed. The conversion of feed into milk by the sow and then its conversion to gains by the pigs is less efficient than a program in which the pigs make their gains by eating the feed directly.

Sows producing large quantities of milk often have difficulty eating enough feed to prevent weight losses during lactation. Since the number of pigs suckled also seems to be related to the amount of milk produced, various workers have studied the relationship between weight gains or losses and the size of litters suckled by the sows.

It was observed by McKenzie (1928) that sows suckling small litters tended to gain rather than lose weight. Hostetter (1929), in a more extensive investigation, observed similar results. In this investigation, 171 sows lost weight during lactation and weaned an average of 6.9 pigs per litter, with an average weaning weight of 29 pounds per pig. The remainder of the group, or 68 sows, gained an average of 27 pounds each

during lactation and weaned litters averaging 5.6 pigs, with an average weaning weight of 27 pounds. Zeller et al. (1937), Burger (1952), Niwa et al. (1951), and Schafer and Granz (1955) obtained similar results.

Allen et al. (1959) stated that the amount of milk produced was closely associated with the amount of weight lost by the sows. The sows lost an average of 0.25 pounds in weight for each additional pound of milk they produced during the lactation period.

It was noted by Richter et al. (1928) that heavy milking sows lost a considerable amount of weight during the first four weeks of lactation, then they neither gained nor lost weights for a period of time, and then gradually gained weight until weaning. Hughes and Hart (1935) observed that ten sows which produced seven or more pounds of milk daily lost an average of fifty-nine pounds of body weight. Seven sows which produced between five and seven pounds of milk lost twenty-three pounds, and five sows which produced less than five pounds of milk daily lost 25 pounds during lactation.

Allen et al. (1959) found that the feed consumption of sows for each pound of milk produced varied from a low of 1.52 pounds in the Landrace to a high of 2.17 pounds in the Durocs. Breed and cross differences were highly significant. Landrace X Poland crossbred sows were almost as efficient in this respect as were the Landrace, requiring an average of 1.57 pounds of feed per pound of milk produced.

The amount of feed required by the sows to produce a pound of gain in the pigs varied from a low of 3.29 pounds for the Landrace sows to a high of 4.60 pounds in the Polands and 4.56 pounds in the Durocs. The

Landrace X Poland sows required 3.66 pounds of feed per pound of pig gain. These differences in sows of the different breeding groups were significant ($P < .05$), Allen et al. (1959).

It was concluded that sows from different breeds and crosses varied significantly in the efficiency of pig production.

MATERIALS AND METHODS

The data for this dissertation were collected at The Ohio State University, Columbus, Ohio.

Four Hampshire and two Duroc sows farrowing 6, 9, 8, 9, 11, and 12 pigs respectively were used in this investigation. These sows and their litters were studied by pairs for a period of six weeks. Each pair of sows farrowed within three days of one another and were managed alike. Two Clay¹/farrowing crates were used to house the sows and litters with a three feet high enclosure around the outside edge of each of the farrowing crates. The crates were seven feet in length and in width. The sows and their litters were housed in these crates for six weeks. The sows were fed outside the farrowing crates and allowed to exercise outside the crates twice daily.

A sliding, drop type partition was constructed in each crate to separate the pigs from the sow when the data were collected.

The pigs' needle teeth were clipped and ears notched soon after birth. The pigs were then marked weekly with yellow paint by using two inch marking irons. By this method the pigs were readily identified and the teat(s) which each one nursed was noted. After the pigs were several days old each pig nursed the same teat(s) except for the usual amount of switching which occurred when they had finished or were nearly finished

¹/ Clay Equipment Company, Cedar Falls, Iowa

suckling at the end of a nursing period.

The pigs were weighed before and after nursing each hour for six hours each week starting at about seven days of age and continuing weekly for six weeks. A two-hour adjustment period was used before each set of data was collected to get the pigs on a schedule of nursing every hour and to assure that each pig had nursed one hour previous to the first weighing. Examples of data collected are shown in Table 25.

Each pig was weighed individually in a box on a dial type Toledo scale.^{2/} The scale was equipped with a paddle and dial which read to the nearest one thousandth of a pound. Four boxes were made of $\frac{1}{4}$ " plywood with hinged tops. They ranged in size from 12" long by 7" wide by 9" high to 25" long by 12" wide by 14" high. A box 26" long by 14" wide by 19" high with an open top was also constructed of 20 gauge aluminum. The pigs were placed in appropriate sized boxes to weigh them. The boxes used served to restrain the pig from jumping about unduly while being weighed. By changing to a larger, more open topped box, the pigs usually stood more quiet and their weights could be taken faster. Before the prenursing weighing operation, the pigs were placed outside the farrowing crate in a 4' by 4' pen and kept on their feet to encourage urination and defecation. As the pigs were weighed they were put back in the farrowing crate with the partition down. As soon as all of the pigs were weighed, which usually took about five to eight minutes depending upon

^{2/} Toledo Scale Number 852992, Toledo Scale Company, Toledo, Ohio

their age and size, they were turned with the sow by raising the partition. The pigs and sows soon became accustomed to this operation as the pigs had a keen appetite and the sows were receptive to nursing. The pigs were usually nursing within two or three minutes after being turned with their mothers. As soon as two or three of the pigs had finished nursing and backed away from the udder, all of the pigs were quickly put back in the 4' by 4' pen and weighed again. They were then put back in the enclosed compartment of the farrowing crate for one hour. The entire weighing and suckling operation took about fifteen minutes.

The two units of farrowing crates and pig compartments were located side by side so that it was not necessary to move the scale to weigh both litters. One litter was weighed on the hour and the other on the half hour at regular one hour intervals.

Two hours after completion of the six hourly nursing periods the sows were milked by a machine especially designed for this purpose. The machine in operation is shown in Figure 1 and is somewhat similar to those developed by Smith et al. (1951), Lodge (1957), and Legagneur (1959).

The machine consisted of two, 2-unit De Laval vacuum pumps, two standard De Laval milk pails and pulsators,^{3/} and two racks each of which held six one pint milk bottles to which the vacuum line and teat cups were attached (Figure 1). Fifteen inches of vacuum and a pulsation rate of 70 per minute were used in this study. A standard, 1 in. O.D.^{4/} rubber

^{3/} Supplied by De Laval Separator Company, Poughkeepsie, New York

^{4/} O.D. is outside diameter, I.D. is inside diameter

tube vacuum line was used to connect the vacuum pump to a pulsator located on each side of the farrowing crate.

The double line vacuum tube was approximately 4-feet long. Five $3/8$ in. O.D. copper T's were spaced 6 inches apart with a 90 degree elbow attached to the end of each vacuum line. Six 36-in. pieces of $1/4$ in. I.D. rubber tubing connected the "T" and "L" joints to the stems of the teat cups. This caused pulsation in alternate teat cups.

The large vacuum line from the pail lid was connected by a $3/8$ in. reducer to a line of five $3/8$ in. O.D. copper T's spaced 2.5 inches apart with a 90 degree elbow on the end. These were attached by 3 in. of $1/4$ in. I.D. rubber tubing to six $1/8$ in. air cocks. Eight inches of rubber tubing were used to connect the air cocks with 3 in. of $3/8$ in. O.D. leucite tubing which was inserted through a number 7 rubber stopper fitted into the milk bottle. A second leucite tube was inserted through the rubber stopper and was connected to 36 in. of $1/4$ in. rubber tubing which connected to the teat cup.

The teat cups were made of $3/4$ in. I.D. brass tubing 2 and $3/8$ in. long. A copper tube 1.5 in. long and $1/4$ in. I.D. cut at a 35-degree angle was soldered over a hole in the casing which was cut at the same angle. A ring was made of $3/32$ in. solid wire, fitted snugly into the topmost part of the casing, and soldered, giving it an I.D. of $9/16$ in. Two smaller sizes of teat cups were made by filling in the rings with paste-type aluminum solder, allowing it to harden and then filing it back to $7/16$ and $1/2$ in. I.D. The fourth and largest size of teat cup ($3/4$ in. I.D.) was made by using the casing without a ring.

The teat cup liner was made of 5/8 in. I.D. pure gum flexible rubber tubing with a 1/16 in. thick wall. The liner (4 in. long) was inserted through the casing and folded back snugly over each end. The lower 1/4 in. of a number 6 cork stopper was cut off and bored so that a 1-1/4 in. length of 5/16 in. O.D. copper tubing fitted snugly through it. A hole 3/64 in. in diameter was bored through one wall of the copper tubing near the cork stopper to allow entrance of the amount of air necessary to keep the line from flooding with milk. The cork stopper was given several coats of Glyptal^{5/} to insure a good seal when pressed into the bottom of the teat cup.

By use of the air cocks any number of teat cups may be used without the loss of vacuum. Since sows may have several teats that are smaller or larger than the others, it was usually necessary to have available teat cups of four different sizes.

Thirty minutes prior to milking a two inch, 20 gauge needle and a hypodermic syringe were used to inject 6-12 c.c. of tranquilizer^{6/} intramuscularly into the ham of a sow to be milked. The exact amount of tranquilizer given depended upon the sows' size and normal docility. The sow was then driven into a milking crate which was constructed from a farrowing crate. The farrowing crate had previously been changed by fitting an end in the crate which could be slid forward to shorten its length and keep the sow from backing up or moving about unduly (Figure 1). The sow was fed at time of milking which kept her occupied and less aware of

^{5/} Apparatus and Maintenance Paint, No. 12-1, General Electric, Chemical Department, Pittsfield, Mass.

^{6/} Sparine Hydrochloride, Wyeth Laboratories, Inc., Philadelphia, Penna.

the milking operation. The sows were fed daily in this crate and had become accustomed to the crate and its surroundings prior to the first time of milking. At milking time the sow was driven into the milking crate, her udder was washed with water, and a 2-inch, 20 gauge needle and hypodermic syringe was used to inject 6 c.c. of Oxytocin^{7/} intramuscularly into her ham.

The vacuum pumps were then started and teat cups were put on immediately. Within 30 seconds, milk let down began and after two to three minutes, the rate of flow decreased sharply. As soon as the rate of flow started to decline, a worker on each side of the sow massaged the glands, a procedure which increased the amount of milk obtained by approximately 10 per cent.

The milk from each gland was weighed to the nearest one-thousandth of a pound in pint milk bottles as shown in Figure 1. The bottles had previously been corrected to the same weight by adding a predetermined number of B.B.'s.^{8/}

The nursing frequency of the pigs was determined by use of a 16 M.M. Bell and Howell movie camera (Figure 2). The camera was adjusted to take single frames and was equipped with a light bar and two Sylvania Super-flood R-32, 375 watt, 115-120 volt bulbs with an average life of 15 hours. The camera was connected by a cable to an electric motor which tripped the camera to expose one frame per minute. The motor was also connected to the light bar and was equipped to turn on the lights approximately

^{7/} Armour Purified Oxytocic Principle, 20 U.S.P. Units per ml. Corn States Laboratories, Inc., Omaha, Nebraska. Donated by Eli Lilly and Company, Indianapolis, Indiana

^{8/} Winchester-Western Division, Olin Mathieson Chemical Corp., New Haven, Conn. and East Alton, Illinois

Figure 1. General Operation of a Milking
Machine for Sows

Figure 2. Camera and Apparatus Used to Determine the
Nursing Frequency of Pigs

ten seconds before the camera was tripped and to turn them off a few seconds later.

This apparatus was placed on a stand ten feet high, and nine feet behind the sow in the farrowing crate.

A clock, with the face painted green and the hands painted white, was tied to a bar of the farrowing crate in order to determine the time of activity of the pigs. By this means (Figure 2) a picture was taken of the sow and pigs every minute for approximately twenty-four hours, starting about the seventh day after farrowing and continued one day each week for six weeks.

By running the developed film slowly through a film strip projector the time of nursing was easily determined. Nursing frequency was calculated by the difference in time from the initial phase of a nursing to the initial phase of the following nursing.

Data of this type were collected on sows number 2, 3, 5 and 6, involving 9, 8, 11, and 12 pigs respectively.

All data collected were analyzed by correlation and by analysis of variance.

RESULTS AND DISCUSSION

This dissertation was designed to study the association of two methods of estimating milk yields of sows and to learn the positional effect of mammary glands of sows and their milk yield.

The two methods studied for estimating milk yield were (1) the weighing of pigs before and after nursing and (2) the milking of the sow by machine.

Samples of the data collected are shown in Tables 23 through 41 in the appendix.

The weighing of pigs before and after nursing is laborious, however, it is probably the most accurate method for determining the actual milk producing ability of the sow. This method was employed to serve as a basis for which the milking machine, a much faster and easier method, could be studied. The method of weighing pigs before and after nursing was tested for accuracy by repeated weighings as shown in Tables 5 through 7. The correlation coefficients for weight of the pigs at the first weighing with the second and third weighings were 0.999, 0.999, and 0.999 respectively.

The correlations (Table 8) show the association between the two methods of measuring lactation performance of sows. The correlation coefficients for amounts of milk obtained by machine and the weight of the pigs during the first through the sixth week, are .27 ($P < 0.05$), .24, .22, .43 ($P < 0.01$), .45 ($P < 0.01$), and .79 ($P < 0.01$) respectively.

It is noted that the coefficients increase after the third week. This may have been due to a more steady production of milk caused by the stimulation of nursing. It could also have been due to the sows becoming more accustomed to the milking procedure thus allowing a more accurate measurement. The sows on this study, however, caused no serious amount of difficulty at any time.

The correlation coefficients (Table 8) between weight of the pigs and milk received, as measured by weighing the pigs before and after nursing at six hourly intervals, each week, were .08, .59 ($P < 0.01$), .62 ($P < 0.01$), .84 ($P < 0.01$), .54 ($P < 0.01$), and .44 ($P < 0.01$) respectively. These coefficients increase up to the fourth week and then decrease. The reason for this is not understood.

Positional Effect of Mammary Glands

The amount of milk nursed from individual teats and that obtained by machine (Table 23) indicates there is a wide variation among glands in the production of milk. Table 9 shows that milk yield is not significantly associated with the location of teats on the left and right side or from front to rear. Table 10 indicates that when the milk yield of opposite teats, left 1 and right 1, was paired from front to rear and tested by an analysis of variance for differences, no significant differences were observed within the limits of the analysis.

There has been much disagreement regarding the location of teats selected by larger and smaller pigs of a litter and the producing ability of the glands selected.

The correlation coefficients (Table 11) for birth weight with position of teat nursed indicates no significant association whereas the two remaining correlations associating birth weight with milk received at hourly nursing intervals and by weekly machine milkings are highly significant. The correlation between the sixth week weight and position of teat nursed was also not significant. This tends to indicate that the pigs did not select a teat(s) for its location or for its milk yielding ability. The reason for selecting a certain teat(s) and claiming it throughout the lactation was not determined in this study.

One might assume that the larger pigs at birth are more vigorous, have a larger appetite, do a more complete job of removing the milk and thus stimulate a heavier milk flow.

Pigs which nursed more than one teat were not used in correlations concerning teat position. Forty-seven pigs in this study were found to be nursing single teats. Their distribution regarding location is shown in Table 12.

Importance of Milk Yield

Milking ability of the sow is essential for pigs to make the rapid gains for which they are bred. Milking ability and prolificacy should go hand in hand in order for a swine operation to be successful. In this study it appears that birth weight is associated with milk yield.

Table 13 shows the milk production of sows as measured by six-hour, once a week nursing periods. By visual inspection, one notes that the sows generally reached their peak of milk production during the third

or fourth week.

Table 14 is an amplification of Table 13. The data were multiplied by 28 in order to put the pounds of milk produced on a weekly basis. This also facilitates a comparison of these results with those of other workers. The greatest amount of milk produced by a sow on this study during a six week period was 723.660 pounds. The least was 338.940 pounds.

Table 15 shows the pounds of milk calculated to have been produced weekly per pig by each sow. It indicates that the total amount of milk produced per pig is greater for small litters than for large litters although it is not directly proportional. There are apparent differences in milk yielding ability of sows as indicated by the difference in production between sow number two and sow number four. Both sows farrowed the same number of pigs, yet there was a difference in milk production per pig of 36.540 pounds in favor of sow number two during the six week lactation period.

The average birth weight per pig of sow number two was .471 pounds greater than the pigs of sow number four (Table 16). This tends to substantiate the importance of size of pigs at birth and their subsequent stimulation of a heavier milk yield as shown by the correlations in Table 11.

Table 16 also shows the weekly gain in weight of the litter per sow. The peak in gains was reached generally during the third or fourth week and closely followed the lactation curve of the sows.

The Nursing Interval of Pigs

The nursing interval, as reported by most research workers, has been determined by actual observation which is a time consuming and costly method. The nursing interval as used in this study was considered to be the time from the beginning of one nursing period to the beginning of the next.

The nursing interval of litters number 2, 3, 5, and 6, involving 9, 8, 11 and 12 pigs respectively was determined by the use of a movie camera.

The nursing intervals determined are shown in Tables 17, 18, 19 and 20. The analysis of variance applied to these data, as shown in Table 21, indicates no significant difference between day and night nursing intervals, but a significant difference between sows in length of nursing intervals. Table 22 shows the average nursing interval for both day and night was 43.5 minutes during the first week and gradually extended to 58.2 minutes by the sixth week. The nursing interval during the night was two minutes shorter than during the day.

TABLE 5

Repeated Weighings of Pigs as Read and Recorded
by Two Operators, May 27, 1960

Read and Recorded by Operator One			
Sow number five farrowed May 16, 1960			
Pig Number	1st Weight	2nd Weight	3rd Weight
	lbs		
1	8.750	8.780	8.815
2	9.680	9.650	9.690
3	6.195	6.195	6.190
4	4.780	4.750	4.770
6	6.085	6.080	6.125
7	7.650	7.650	7.700
8	7.880	7.870	7.880
9	8.285	8.285	8.245
10	7.840	7.840	7.785
11	7.465	7.455	7.440
12	4.510	4.500	4.520
Read and Recorded by Operator Two			
1	8.770	8.775	8.820
2	9.680	9.650	9.685
3	6.195	6.195	6.190
4	4.780	4.755	4.770
6	6.085	6.080	6.130
7	7.655	7.650	7.700
8	7.880	7.870	7.880
9	8.285	8.280	8.250
10	7.840	7.840	7.785
11	7.465	7.460	7.440
12	4.510	4.500	4.520

Correlation Coefficient for:

1st weight with 2nd weight = 0.999 ($P < 0.01$)

1st weight with 3rd weight = 0.999 ($P < 0.01$)

2nd weight with 3rd weight = 0.999 ($P < 0.01$)

TABLE 6

Repeated Weighings of Pigs as Read and Recorded
by Two Operators, June 6, 1960

Read and Recorded by Operator One			
Sow number five farrowed May 16, 1960			
Pig Number	1st Weight	2nd Weight	3rd Weight
	lbs		
1	13.600	13.590	13.610
2	13.820	13.820	13.800
3	9.575	9.575	9.570
4	7.350	7.350	7.335
6	9.810	9.800	9.810
7	10.770	10.700	10.750
8	11.660	11.650	11.670
9	12.250	12.230	12.260
10	11.990	11.970	11.965
11	11.890	11.860	11.870
12	6.950	6.980	6.970
Read and Recorded by Operator Two			
1	13.620	13.580	13.610
2	13.820	13.815	13.805
3	9.575	9.575	9.585
4	7.350	7.355	7.335
6	9.810	9.800	9.815
7	10.775	10.700	10.750
8	11.660	11.650	11.680
9	12.250	12.230	12.270
10	11.990	11.960	11.960
11	11.885	11.855	11.870
12	6.940	6.980	6.970

Correlation Coefficient for:

1st weight with 2nd weight = 0.999 ($P < 0.01$)

1st weight with 3rd weight = 0.999 ($P < 0.01$)

2nd weight with 3rd weight = 0.999 ($P < 0.01$)

TABLE 7

Repeated Weighings of Pigs as Read and Recorded
by Two Operators, June 27, 1960

Read and Recorded by Operator One			
Sow number five farrowed May 16, 1960			
Pig Number	1st Weight	2nd Weight	3rd Weight
	lbs		
1	17.410	17.420	17.430
2	19.450	19.455	19.460
3	13.770	13.790	13.460
4	10.230	10.225	10.240
6	15.255	15.250	15.270
7	12.570	12.560	12.580
8	18.605	18.605	18.605
9	18.400	18.410	18.440
10	17.265	17.260	17.270
11	16.790	16.790	16.795
12	9.320	9.315	9.325
Read and Recorded by Operator Two			
1	17.430	17.415	17.420
2	19.460	19.465	19.450
3	13.785	13.790	13.785
4	10.230	10.240	10.235
6	15.265	15.260	15.250
7	12.580	12.560	12.580
8	18.605	18.600	18.605
9	18.415	18.440	18.415
10	17.270	17.265	17.275
11	16.800	16.800	16.795
12	9.330	9.325	9.325

Correlation Coefficient for:

1st weight with 2nd weight = 0.999 ($P < 0.01$)

1st weight with 3rd weight = 0.999 ($P < 0.01$)

2nd weight with 3rd weight = 0.999 ($P < 0.01$)

TABLE 8

Correlations of Weight of Pigs with Amount of Milk Obtained
by Machine and Amount of Milk Nursed by Pigs

Weight of 55 Pigs with Amount of Milk Obtained by Machine

1st Week	27*
2nd Week	24
3rd Week	22
4th Week	43**
5th Week	45**
6th Week	79**

Weight of 55 Pigs with Amount of Milk Received by 55 Pigs as
Measured by Six Hourly Nursing Intervals

1st Week	08
2nd Week	59**
3rd Week	62**
4th Week	94**
5th Week	54**
6th Week	44**

* $P < 0.05$

** $P < 0.01$

TABLE 9

The Association of Milk Yield in Pounds with Location
of Teats on the Left and Right Side and from Front to Rear

Teat Pos. ^{a/}	Sow #1	Sow #2	Sow #3	Sow #4	Sow #5	Sow #6	Sum	(Sum) ² n
L1	.....	2.705	1.480	.....	3.035	1.270	8.490	18.020
L2	2.785	2.595	1.830	.....	2.540	2.205	11.755	27.636
L3	.....	2.725	.....	1.685	2.500	2.435	9.345	21.852
L4	.....	5.045	.....	.....	2.530	1.035	6.610	14.564
L5	.....	2.490	.....	.....	.....	1.480	3.970	7.860
L6	.....	.....	.....	1.535	1.900	2.605	6.040	12.160
Total	2.785	13.360	3.510	3.220	12.505	11.030	46.210	102.092
R1	3.815	2.470	1.650	.....	2.465	3.175	13.575	36.856
R2	3.260	2.365	1.500	1.205	2.300	2.395	13.025	28.275
R3	.....	2.670	1.755	1.060	2.820	2.675	10.980	24.112
R4	4.200	2.965	1.665	.....	1.745	1.820	12.415	30.826
R5	3.420	.....	.....	.....	.....	2.360	5.780	16.704
R6	.....	.....	.....	0.945	1.595	2.390	4.930	8.101
Total	14.705	10.490	6.570	3.210	10.925	14.815	60.705	144.874
Grand Total							106.915	246.966
Source of Variation			D.F.	S.S.		M.S.		F.
Total			46	24.628		....		....
Treatment			11	3.758		0.341		....
Left vs. Right			1	0.210		0.210		N.S.
Among Left			5	0.408		0.082		N.S.
Among Right			5	3.140		0.628		N.S.
Error			35	20.870		0.596		.....

a/ L 1 - L 6 - Teats on left side, front to rear, respectively.

R 1 - R 6 - teats on right side, front to rear, respectively.

TABLE 10

The Comparison of Milk Yield between Paired Teats
as Measured by Pig Weights

Paired Teats ^a /	Sow #1	Sow #2	Sow #3	Sow #4	Sow #5	Sow #6	Sum	$\frac{(\text{Sum})^2}{n}$
	(1b)							
L1	.....	2.705	1.480	.....	3.035	1.270		
R1	.....	<u>2.470</u>	<u>1.650</u>	.....	<u>2.465</u>	<u>3.175</u>		
Total	.....	5.175	3.130	.....	5.500	4.445	18.250	83.265
L2	2.785	2.395	1.830	.....	2.540	2.205		
R2	<u>3.260</u>	<u>2.365</u>	<u>1.500</u>	.....	<u>2.300</u>	<u>2.395</u>		
Total	6.045	4.760	3.330	.....	4.840	4.600	23.575	111.156
L3	.....	2.725	.....	1.685	2.500	2.435		
R3	.....	<u>2.670</u>	.....	<u>1.060</u>	<u>2.820</u>	<u>2.675</u>		
Total	3.465 ^b /	5.395	.....	2.745	5.320	5.110	22.035	97.108
L4	.....	3.045	.....	.....	2.530	1.035		
R4	.....	<u>2.985</u>	.....	.....	<u>1.745</u>	<u>1.820</u>		
Total	.....	6.030	.....	.....	4.275	2.855	13.160	57.728
L5	.....	.....	.....	.....	.....	1.480		
R5	.....	.....	.....	.....	.....	<u>2.360</u>		
Total	.....	.....	.....	.....	2.080 ^b /	3.840	5.920	17.523
L6	.....	.....	.....	1.535	1.900	2.605		
R6	.....	.....	.....	<u>.945</u>	<u>1.595</u>	<u>2.390</u>		
Total	.....	.....	2.265 ^b /	2.480	3.495	4.995	13.235	43.791
L7	.....	.....	.....	.....	.....	.....		
R7	.....	.....	.....	.....	.....	.....		
Total	.....	.....	.....	.850 ^b/	.....	.....	.850	.723
Sum	9.510	21.360	8.725	6.075	25.510	25.845	97.025	411.294
$\frac{(\text{Sum})^2}{n}$	45.220	114.062	25.375	13.301	108.460	111.327	416.745	
Source of Variance	D.F.		S.S.		M.S.		F.	
Total	23		43.306		.....		.....	
Treatment	6		19.051		3.175		2.225	
Error	7		24.255		1.427		.....	

a/ L1 -- L7 = teats on left side, front to rear, respectively

R1 -- R7 = teats on right side, front to rear, respectively

b/ Amount of milk received by one pig nursing both teats

TABLE 11
Correlation of Birth Weight with Milk
Received and Teat Position

Association			Correlation Coefficient
Birth Weight of 55 Pigs	with	Total Milk Received by 55 Pigs during 6 Weeks as Measured by 36 Hourly Nursing Intervals	.60**
Birth Weight of 55 Pigs	with	Total Milk Obtained by Machine during 6 Weekly Milkings	.42**
Birth Weight of 47 Pigs	with	Position of Teat Nursed by Pigs	-.06
6th Week Weight of 47 Pigs	with	Position of Teat Nursed by Pigs	-.22

** $P < 0.01$

TABLE 12
The Location of Teats
Nursed by Forty-seven Pigs

Left side

Teat position, front to rear

1	2	3	4	5	6	7
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
4	6	4	2	3	3	0

Number of pigs suckling teat

Right side

Teat position, front to rear

1	2	3	4	5	6	7
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
5	5	5	5	2	3	0

Number of pigs suckling teat

TABLE 13

Pounds of Milk Produced by Sows as Measured
by One Six-Hour Nursing Period Each Week for Six Weeks

Week of Lactation	Sow Number One 6 Pigs	Sow Number Two 9 Pigs	Sow Number Three 8 Pigs	Sow Number Four 9 Pigs	Sow Number Five 11 Pigs	Sow Number Six 12 Pigs
1st Wk.	2.920	4.260	1.980	1.630	4.810	4.995
2nd Wk.	4.080	4.430	1.995	2.230	4.650	4.160
3rd Wk.	5.245	4.030	2.640	2.760	4.315	5.080
4th Wk.	4.160	5.030	2.870	2.120	4.510	3.530
5th Wk.	2.600	3.655	2.260	1.985	4.045	4.130
6th Wk.	<u>1.940</u>	<u>2.445</u>	<u>2.450</u>	<u>1.380</u>	<u>3.180</u>	<u>3.950</u>
Total	20.945	23.850	14.195	12.105	25.510	25.845

TABLE 14

Pounds of Milk Produced by Sows Measured
by Six Hourly Nursing Periods Calculated for One Week^{a/}

Week of Lactation	Sow Number One 6 Pigs	Sow Number Two 9 Pigs	Sow Number Three 8 Pigs	Sow Number Four 9 Pigs	Sow Number Five 11 Pigs	Sow Number Six 12 Pigs
1st Wk.	81.760	119.280	55.440	45.640	134.680	139.860
2nd Wk.	114.240	124.040	55.860	62.440	130.200	116.480
3rd Wk.	146.860	112.840	73.920	77.280	120.820	142.240
4th Wk.	116.480	140.840	80.360	59.360	126.280	98.840
5th Wk.	72.800	102.340	63.280	55.580	113.260	115.640
6th Wk.	<u>54.320</u>	<u>68.460</u>	<u>68.600</u>	<u>38.640</u>	<u>89.040</u>	<u>110.600</u>
Total	586.460	667.800	397.460	338.940	714.280	723.660

^{a/} The amounts of milk in Table 13 were multiplied by 28 to put the values on a weekly basis.

TABLE 15
Pounds of Milk Produced Weekly
per Pig by Each Sow

Week of Lactation	Sow Number One 6 Pigs	Sow Number Two 9 Pigs	Sow Number Three 8 Pigs	Sow Number Four 9 Pigs	Sow Number Five 11 Pigs	Sow Number Six 12 Pigs
1st Wk.	13.627	13.253	6.930	5.071	12.244	11.655
2nd Wk.	19.040	13.782	6.983	6.938	11.836	9.707
3rd Wk.	24.477	12.538	9.240	8.587	10.984	11.853
4th Wk.	19.413	15.649	10.045	6.596	11.480	8.237
5th Wk.	12.133	11.371	7.910	6.176	10.296	9.637
6th Wk.	<u>9.053</u>	<u>7.607</u>	<u>8.575</u>	<u>4.293</u>	<u>8.095</u>	<u>9.217</u>
Total	97.743	74.200	49.683	37.660	64.935	60.305

TABLE 16
Gain in Weight of Litter
per Sow per Week

Week of Lactation	Sow Number One 6 Pigs	Sow Number Two 9 Pigs	Sow Number Three 8 Pigs	Sow Number Four 9 Pigs	Sow Number Five 11 Pigs	Sow Number Six 12 Pigs
Ave. Birth Weight	3.800	3.287	2.851	2.816	3.059	2.866
Total Birth Weight	22.800	29.580	22.805	25.340	33.655	34.390
1st Wk. Gain	23.330 .530	39.690 10.110	37.495 14.690	32.460 7.120	25.205 -8.450	25.495 -8.895
2nd Wk. Gain	45.160 21.830	68.410 28.720	46.055 8.560	40.805 8.345	48.325 23.120	40.750 15.255
3rd Wk. Gain	71.620 26.460	103.240 34.830	60.320 14.265	51.255 10.450	79.965 31.640	63.375 22.625
4th Wk. Gain	95.400 23.780	121.910 18.670	86.775 26.455	73.265 22.010	101.890 21.925	85.520 22.145
5th Wk. Gain	113.780 18.380	140.125 18.215	96.265 9.490	81.850 8.585	112.940 11.050	106.580 21.060
6th Wk. Gain	124.230 <u>10.450</u>	151.695 <u>11.570</u>	104.710 <u>8.445</u>	90.940 <u>9.090</u>	135.760 <u>22.820</u>	130.190 <u>23.610</u>
Total Gain	101.430	122.115	81.905	65.600	110.555	104.695

TABLE 17

Nursing Interval of Sow Number Two
as Determined by a Movie Camera

Farrowed nine pigs January 22, 1960											
1st Wk. 1-28-60		2nd Wk. 2-4-60		3rd Wk. 2-11-60		4th Wk. 2-18-60		5th Wk. 2-25-60		6th Wk. 3-3-60	
min.		min.		min.		min.		min.		min.	
day	night	day	night	day	night	day	night	day	night	day	night
35	20	50	50	60	50	60	55	75	40	50	70
60	20	55	25	20	50	70	75	45	50	50	55
35	20	50	60	80	40	80	45	60	50	70	45
30	35	45	30	35	75	80	55	70	50	65	60
30	20	45	30	35	40	65	50	20	55	30	50
60	30	55	55	50	55	55	45	60	55	55	65
35	35	50	55	50	60	60	55	65	55	50	80
35	40	80	55	55	35	60	55	55	75		60
25	25	55	50	85	35	50	60	65	60		75
30	30	35	40	50	45		35	75	60		60
40	15	40	60	35	40			40			
45	30	25	55	45				70			
30		60	45	95							
45		40	55								
30			45								
45			55								
40			60								
60			60								
Mean											
40.0	27.0	49.3	49.1	53.5	47.7	64.4	53.0	58.3	55.4	54.3	62.0
	34.0		49.2		50.8		58.4		57.0		58.8

TABLE 18

Nursing Interval of Sow Number Three
as Determined by a Movie Camera

Farrowed Eight Pigs March 23, 1960											
1st Wk. 5-21-60		2nd Wk. 5-25-60		3rd Wk. 6-2-60		4th Wk. 6-9-60		5th Wk. 6-15-60		6th Wk. 6-23-60	
min.		min.		min.		min.		min.		min.	
day	night	day	night	day	night	day	night	day	night	day	night
55	50	55	65	45	60	60	50	65	45	70	70
50	55	55	35	55	20	110	55	80	60	65	60
90	45	50	30	70	60	125	60	70	30	90	70
55	55	60	40	40	60	60	60	50	55	60	65
60	35	50	25	60	75	65	60	50	85	65	60
50	40	50	50	85	75	45	65	60	70	60	65
45	30	25		60	70	40	70	60	80	55	70
	30	75		65	80	60	70	90	65	65	70
	45	75		50	65	70	65	60	65	60	80
	25	55		50	60	55	65	70	65	55	100
		40		75			65	45	65	65	45
		60						75		55	
		65						55		50	
		70								35	
		50								40	
Mean											
57.9	41.0	55.7	41.0	59.6	63.0	69.0	62.2	63.9	62.0	59.2	69.0
	48.0		51.4		61.0		66.0		63.0		64.0

TABLE 19

Nursing Interval of Sow Number Five
as Determined by a Movie Camera

Farrowed Eleven Pigs May 16, 1960											
1st Wk. 3-28-60		2nd Wk. 4-1-60		3rd Wk. 4-7-60		4th Wk. 4-14-60		5th Wk. 4-21-60		6th Wk. 4-28-60	
min.		min.		min.		min.		min.		min.	
day	night	day	night	day	night	day	night	day	night	day	night
10	15	55	15	60	45	50	25	35	30	60	35
20	15	35	50	45	40	30	40	20	65	70	40
55	20	50	15	20	40	20	40	60	25	30	110
40	40	35	60	30	40	20	35	45	45	35	60
55	40	15	25	60	45	30	45	40	40	45	25
35	50	35	15	30	35	10	15	40	40	60	60
45	50	25	45	40	45	15	20	25	35	35	55
45	45	35	35	40	35	50	45	45	40	40	25
35	35	30	40	40	40	30	40	45	65	30	55
45	50	45	25	50	65	45	40		40	40	35
30	15	40	60	45	40	35	40		55	30	
40	30	50	35	40	45	40	50		35	35	
45		45	60	45	20	30	40		45	30	
25			30	40		60	45		55	45	
35			50	25		40	45		60	30	
45			25	35		35	35		35		
40				35		25					
30				25		60					
				25							
				35							
Mean											
37.8	34.2	38.1	36.6	38.3	41.2	34.7	37.5	39.4	44.4	41.0	50.0
36.3		37.2		39.4		36.0		42.6		44.6	

TABLE 20

Nursing Interval of Sow Number Six
as Determined by a Movie Camera

Farrowed Twelve Pigs on May 16, 1960											
1st Wk. 5-22-60		2nd Wk. 5-26-60		3rd Wk. 6-3-60		4th Wk. 6-10-60		5th Wk. 6-16-60		6th Wk. 6-24-60	
min.		min.		min.		min.		min.		min.	
day	night	day	night	day	night	day	night	day	night	day	night
60	25	70	50	60	55	60	50	40	80	50	55
60	60	80	45	55	55	55	50	60	45	35	65
50	40	60	40	35	40	65	55	50	60	155	60
55	30	75	55	30	60	60	65	55	55	55	40
60	65	65	70	45	70	70	50	60	60	55	75
55	55	75	55	60	70	60	70	40	65	60	55
60	35	105	50	75	80	70	55	35	65	85	85
70	50	40	70	55	60	60	60	60	35	70	55
70	65	75	65	60	60	50		45	60	55	
40	60	75	50	60		80		75	70		
40	50		60	50		50		65	70		
	55		50	25		65					
	110		55	90		60					
	70		100			65					
Mean											
56.4	55.0	72.0	58.2	53.9	61.1	62.0	57.0	53.2	60.5	69.0	61.3
56.0		64.0		57.0		60.0		57.0		66.0	

TABLE 21

Nursing Interval in Minutes of 40 Pigs of Sows No. 2, 3, 5, and 6
Respectively as Determined by a Movie Camera

	1st Wk.	2nd Wk.	3rd Wk.	4th Wk.	5th Wk.	6th Wk.	Total	
Ave.	36.3	37.2	39.4	36.0	42.6	44.6	.....	
Day	37.8	38.1	38.3	34.7	39.4	41.0	229.3	
Night	34.2	36.6	41.2	37.5	44.4	50.0	243.9	
Total	72.0	74.7	79.5	72.2	83.8	91.0	473.2	
<hr/>								
Ave.	34.0	49.2	50.8	58.4	57.0	58.8	.....	
Day	40.0	49.3	53.5	64.4	58.3	54.3	319.8	
Night	27.0	49.1	47.7	53.0	55.4	62.0	294.2	
Total	67.0	98.4	101.2	117.4	113.7	116.3	614.0	
<hr/>								
Ave.	47.9	51.4	61.0	65.5	63.0	63.7	.....	
Day	57.9	55.7	59.6	69.0	63.9	59.2	365.3	
Night	41.0	40.8	62.5	62.2	62.0	68.6	337.1	
Total	98.9	96.5	122.1	131.2	125.9	127.8	702.4	
<hr/>								
Ave.	55.6	63.9	56.8	59.8	56.8	65.6		Grand
Day	56.4	72.0	53.9	61.7	53.2	69.0	366.2	Total
Night	55.0	58.2	61.1	56.9	60.5	61.3	353.0	1280.6
Total	111.4	130.2	115.0	118.6	113.7	130.3	719.2	1228.2
<hr/>								2508.8
<hr/>								
Source of Variation	D.F.		S.S.		M.S.		F.	
Total	47		5763.07					
Replications	23		4977.12		216.39		6.83**	
Treatments	1		57.20		57.20		1.80	
Error	23		728.75		31.68			

**P < 0.01

TABLE 22

The Average Nursing Interval in Minutes during
Day and Night of Forty Pigs of Sows Number
Two, Three, Five and Six as Determined by Movie Camera

<u>Day</u>						
1st Wk.	2nd Wk.	3rd Wk.	4th Wk.	5th Wk.	6th Wk.	Average
48.0	53.8	51.3	57.5	53.7	55.9	53.4
<u>Night</u>						
39.3	46.2	53.1	52.4	55.6	60.5	51.4
<u>Average of Day and Night</u>						
43.5	50.4	52.0	54.9	54.9	58.2	52.3

SUMMARY AND CONCLUSIONS

The amounts of milk obtained by the use of a milking machine were found to be correlated with the weight of the pigs. Significant correlation coefficients of the weights of pigs with amounts of milk obtained by machine during the first through the sixth week were .27 ($P < 0.05$), .24, .22, .43 ($P < 0.01$), .45 ($P < 0.01$), and .78 ($P < 0.01$) respectively. It was noted that the correlation coefficient increased rapidly after the third week of lactation. No complete explanation is offered.

The correlation coefficients for weights of pigs and amounts of milk received by them as measured by six hourly nursing intervals each week during the first through the sixth week were .08, .59 ($P < 0.01$), .62 ($P < 0.01$), .84 ($P < 0.01$), .54 ($P < 0.01$), and .44 ($P < 0.01$) respectively. Although the correlation coefficients for the second through the sixth week were significant ($P < 0.01$) no explanation was apparent for the high value of .84 ($P < 0.01$) during the fourth week of lactation.

It was found that there were large differences in milk yield between glands but no individual gland(s) was consistently a large or small producer. When the teats were paired laterally from front to rear and differences in milk yield were studied, no significant difference was found by the analysis used. Neither was there any significant difference in milk yield between glands located on the left and right side.

It was found that pigs do not establish themselves on a certain teat(s) because of its location or milk production. Their reason for

choosing a certain teat(s) is not understood. It appeared that the larger pigs, which could be assumed to be more vigorous, emptied their glands more completely when nursing and thus stimulated greater milk production.

The nursing frequency was observed to lengthen somewhat with the advance of lactation and the milk yield per pig per week was found to decrease with advance of lactation.

APPENDIX

TABLE 23

Six-Week Record of Milk Taken per Pig at Hourly Nursing
Interval and Milk Obtained by Machine after a Two-Hour Interval

Sow #1, Hampshire, farrowed 1-23-60							
1-30-60	L1 ^a /	2	3	4	5	6	Total
Pig No. ^b /	-	2	5	-	-	-	
9:00 A.M.		.120					.120
10:00 A.M.		.080					.080
11:00 A.M.		.050					.050
12:00 A.M.		.030					.030
1:00 P.M.		.000					.000
2:00 P.M.		.070					.070
Total		.350					.350
Milking Machine ^c /		.084	.040				.124
1-30-60	R1 ^a /	2	3	4	5	6	Total
9:00 A.M.	.150	.140	.110	.150	.130		.680
10:00 A.M.	.120	.110	.130	.150	.110		.620
11:00 A.M.	.020	.090	.020	.130	.020		.280
12:00 P.M.	.100	.020	.080	.040	.050		.290
1:00 P.M.	.060	.080	.030	.100	.040		.310
2:00 P.M.	.060	.090	.070	.120	.050		.390
Total	.510	.530	.440	.690	.400		2.570
Milking Machine ^c /	.086	.092	.092	.098	.135		.530

a/ L1 - 6, R1 - 6 = teats on left and right side, front to rear, respectively.

b/ Individual pig which nursed the respective teat(s).

c/ The yield of milk, obtained by machine, at a single milking, from teat(s), nursed by an individual pig.

TABLE 23 (CONTINUED)

Sow #1, Hampshire, farrowed 1-23-60							
2-6-60	Ll ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	-	2	5	-	-	-	
9:00 A.M.		.080					.080
10:00 A.M.		.090					.090
11:00 A.M.		.110					.110
12:00 P.M.		-.020					-.020
1:00 P.M.		.120					.120
2:00 P.M.		.020					.020
Total		.400					.400
Milking Machine ^{c/}		.182	.063				.245
2-6-60	Rl ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	6	4	5	1	3	-	
9:00 A.M.	.230	.110	.140	.120	.140		.740
10:00 A.M.	.140	.120	.120	.140	.070		.590
11:00 A.M.	.100	.120	.120	.200	.110		.650
12:00 P.M.	.120	.040	.130	.190	.030		.510
1:00 P.M.	.120	.140	.120	.130	.110		.620
2:00 P.M.	.120	.070	.120	.110	.150		.570
Total	.830	.600	.750	.890	.610		3.680
Milking Machine ^{c/}	.069	.184	.153	.262	.221		.889

a/ Ll - 6, Rl - 6 = teats on left and right side, front to rear, respectively

b/ Individual pig which nursed the respective teat(s).

c/ The yield of milk, obtained by machine, at a single milking, from teat(s), nursed by an individual pig.

TABLE 23(CONTINUED)

Sow #1, Hampshire, farrowed 1-23-60

2-13-60	L1 ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	-	2	5	-	-	-	
9:00 A.M.		.220					.220
10:00 A.M.		.145					.145
11:00 A.M.		.230					.230
12:00 P.M.		.120					.120
1:00 P.M.		.080					.080
2:00 P.M.		.070					.070
Total		.865					.865
Milking Machine ^{c/}		.187	.116				.303
2-13-60	R1 ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	6	4	5	1	3	-	
9:00 A.M.	.250	.240	.210	.190	.240		1.130
10:00 A.M.	-.020	-.100	.155	.190	.155		.380
11:00 A.M.	.240	.230	.260	.280	.260		1.270
12:00 P.M.	.170	.130	.040	-.050	.150		.440
1:00 P.M.	.140	.170	.100	.160	.050		.620
2:00 P.M.	.100	.060	.160	.140	.080		.540
Total	.980	.730	.925	.910	.935		4.380
Milking Machine ^{c/}	.237	.091	.130	.227	.076		.811

a/ L1 - 6, R1 - 6 = teats on left and right side, front to rear, respectively.

b/ Individual pig which nursed the respective teat(s).

c/ The yield of milk, obtained by machine, at a single milking, from teat(s), nursed by an individual pig.

TABLE 23 (CONTINUED)

Sow #1, Hampshire, farrowed 1-23-60							
2-20-60	L1 ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	-	2	5	-	-	-	
9:30 A.M.		.100					.100
10:30 A.M.		.100					.100
11:30 A.M.		.120					.120
12:30 P.M.		.150					.150
1:30 P.M.		.080					.080
2:30 P.M.		.100					.100
Total		.650					.650
Milking Machine ^{c/}		.132	.063				.195
2-20-60	R1 ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	6	4	5	1	3	-	
9:30 A.M.	.140	.030	.130	.110	.130		.540
10:30 A.M.	.140	.140	.080	.090	.160		.610
11:30 A.M.	.120	.120	.130	.150	.180		.700
12:30 P.M.	.120	.110	.100	.080	.110		.520
1:30 P.M.	.140	.170	.130	.070	.110		.620
2:30 P.M.	.100	.090	.030	.200	.100		.520
Total	.760	.660	.600	.700	.790		3.510
Milking Machine ^{c/}	.202	.102	.110	.234	.122		.770

a/ L1 - 6, R1 - 6 = teats on left and right side, front to rear, respectively.

b/ Individual pig which nursed the respective teat(s).

c/ The yield of milk, obtained by machine, at a single milking, from teat(s), nursed by an individual pig.

TABLE 23 (CONTINUED)

Sow #1, Hampshire, farrowed - 1-23-60							
2-27-60	Ll ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	-	2	5	-	-	-	
9:30 A.M.		.080					.080
10:30 A.M.		.080					.080
11:30 A.M.		.085					.085
12:30 P.M.		.030					.030
1:30 P.M.		.020					.020
2:30 P.M.		.060					.060
Total		.355					.355
Milking Machine ^{c/}		.250	.115				.365
2-27-60	Rl ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	6	4	5	1	3	-	
9:30 A.M.	.095	.100	.085	.125	.100		.505
10:30 A.M.	.110	.095	.080	.120	.075		.480
11:30 A.M.	.105	.030	.065	.035	.090		.325
12:30 P.M.	.060	.070	.065	.055	.060		.310
1:30 P.M.	.080	.065	.045	.080	.065		.335
2:30 P.M.	.035	.070	.065	.065	.055		.290
Total	.485	.430	.405	.480	.445		2.245
Milking Machine ^{c/}	.288	.219	.187	.144	.268		1.106

a/ Ll - 6, Rl - 6 = teats on left and right side, front to rear, respectively.

b/ Individual pig which nursed the respective teat(s).

c/ The yield of milk, obtained by machine, at a single milking, from teat(s), nursed by an individual pig.

TABLE 23 (CONTINUED)

Sow #1, Hampshire, farrowed 1-23-60							
3-5-60	Ll ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	-	2	5	-	-	-	
9:30 A.M.		.045					.045
10:30 A.M.		.025					.025
11:30 A.M.		.045					.045
12:30 P.M.		.040					.040
1:30 P.M.		-.030					-.030
2:30 P.M.		.040					.040
Total		.165					.165
Milking Machine ^{c/}		.175	.105				.280
3-5-60	Rl ^{a/}	2	3	4	5	6	Total
Pig No. ^{b/}	6	4	5	1	3	-	
9:30 A.M.	.130	.075	.050	.130	.060		.445
10:30 A.M.	.020	.030	.090	.025	.015		.180
11:30 A.M.	.040	.050	.045	.150	.060		.345
12:30 P.M.	.065	.050	.060	.050	.030		.225
1:30 P.M.	.055	.050	.055	.065	.040		.265
2:30 P.M.	.040	.055	.045	.110	.035		.285
Total	.350	.310	.345	.530	.240		1.775
Milking Machine ^{c/}	.208	.222	.134	.253	.232		1.049

a/ Ll - 6, Rl - 6 = teats on left and right side, front to rear, respectively.

b/ Individual pig which nursed the respective teat(s).

c/ The yield of milk, obtained by machine, at a single milking, from teat(s), nursed by an individual pig.

TABLE 24

Birth Weight, Teat-Nursed, and Weight^{a/} of Pigs per Week of Sow Number One
Farrowed January 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Weight of Pig 1st Wk.	Weight of Pig 2nd Wk.	Weight of Pig 3rd Wk.	Weight of Pig 4th Wk.	Weight of Pig 5th Wk.	Weight of Pig 6th Wk.
1	3.980	R 4	4.780	8.945	14.140	19.270	22.225	24.770
2	3.850	L 2	3.600	7.030	11.360	15.010	17.925	18.990
3	3.980	R 5	3.620	7.355	11.710	15.470	18.675	20.455
4	3.890	R 2	3.700	7.170	11.200	14.790	17.450	19.145
5	3.860	L3 & R3	3.700	7.010	11.320	15.040	18.440	20.050
6	<u>3.240</u>	R 1	<u>3.930</u>	<u>7.650</u>	<u>11.890</u>	<u>15.820</u>	<u>19.065</u>	<u>20.820</u>
Total Pounds	22.800		23.330	45.160	71.620	95.400	113.780	124.230

^{a/} Taken during the first six weeks, excluding birth weight

^{b/} L1 - L 7 = teats on left side, front to rear, respectively.

R1 - R 7 = teats on right side, front to rear, respectively.

TABLE 25

Birth Weight, Teat-Nursed, and Weight^{a/} of Pigs per Week of Sow Number Two
Farrowed January 22, 1960

Pig No.	Birth Wt.	Teat Nursed by Pig ^{b/}	Weight of Pig 1st Wk.	Weight of Pig 2nd Wk.	Weight of Pig 3rd Wk.	Weight of Pig 4th Wk.	Weight of Pig 5th Wk.	Weight of Pig 6th Wk.
	(lb.)					(lb.)		
1	3.510	L1	5.000	8.590	12.020	14.970	17.250	18.390
2	3.160	R2	4.380	7.230	10.000	12.570	14.475	15.490
3	2.980	R1	5.210	8.470	11.190	13.800	15.605	16.970
4	2.650	L2	3.200	5.670	7.950	10.190	11.665	12.460
6	3.900	L3	5.020	8.690	12.090	15.540	17.715	19.385
7	3.465	L4	5.205	8.645	19.195	15.435	17.520	18.820
8	3.675	R3	4.295	7.215	10.255	12.975	14.750	16.020
9	3.170	L5	3.580	6.720	9.820	12.320	14.465	15.650
10	<u>3.070</u>	R4	<u>3.800</u>	<u>7.180</u>	<u>10.720</u>	<u>14.110</u>	<u>16.680</u>	<u>18.520</u>
Total Pounds	29.580		39.690	68.410	103.240	121.910	140.125	151.695

a/ Taken during the first six weeks, excluding birth weight.

b/ L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 26

Birth Weight, Teat-Nursed, and Weight^{a/} of Pigs Per Week of Sow Number Three
Farrowed March 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig	Weight of Pig 1st Wk.	Weight of Pig 2nd Wk.	Weight of Pig 3rd Wk.	Weight of Pig 4th Wk.	Weight of Pig 5th Wk.	Weight of Pig 6th Wk.
1	3.060	R2	4.585	5.670	7.180	10.710	12.300	13.165
2	3.210	L2	4.010	5.090	7.325	9.585	11.005	12.145
3	3.055	R3	4.700	5.665	7.165	10.355	11.555	13.080
4	2.935	R1	3.990	4.925	7.150	9.325	10.450	11.655
5	2.930	L3 and L4	5.400	6.640	8.600	12.930	14.630	15.875
6	2.500	L5 and R5	5.080	6.070	7.845	11.400	12.395	13.480
7	2.205	L1	4.080	5.005	5.905	8.450	9.380	10.410
8	<u>2.910</u>	R4	<u>5.690</u>	<u>6.990</u>	<u>9.150</u>	<u>14.020</u>	<u>14.550</u>	<u>14.900</u>
Total Pounds	22.805		37.495	46.055	60.320	86.775	96.265	104.710

a/ Taken during the first six weeks, excluding birth weight.

b/ L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 27

Birth Weight, Teat-Nursed, and Weight^{a/} of Pigs per Week of Sow Number Four
Farrowed March 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Weight of Pig 1st Wk.	Weight of Pig 2nd Wk.	Weight of Pig 3rd Wk.	Weight of Pig 4th Wk.	Weight of Pig 5th Wk.	Weight of Pig 6th Wk.
1	3.140	L3	4.000	4.925	5.905	8.545	9.520	10.445
2	3.020	R6	2.960	3.170	3.895	5.365	6.140	6.580
3	2.850	L4 and L5	4.410	5.680	7.375	9.850	11.230	12.535
4	3.190	L6	5.100	6.335	8.005	11.150	12.715	14.045
6	3.030	R4 and R5	4.450	5.645	7.055	9.805	11.030	12.490
7	2.560	R2	2.960	3.835	4.690	6.935	7.910	8.985
8	2.560	R3	2.980	3.820	4.770	7.460	7.945	9.050
9	2.640	L1 and L2	2.650	3.655	5.085	7.695	8.710	9.770
10	<u>2.350</u>	L7 and R7	<u>2.950</u>	<u>3.740</u>	<u>4.475</u>	<u>6.460</u>	<u>6.650</u>	<u>7.040</u>
Total Pounds	25.340		32.460	40.805	51.255	73.265	81.850	90.940

^{a/} Taken during the first six weeks, excluding birth weight.

^{b/} L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 28

Birth Weight, Teat-Nursed, and Weight^{a/} of Pigs Per Week of Sow Number Five
Farrowed May 16, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Weight of Pig 1st Wk.	Weight of Pig 2nd Wk.	Weight of Pig 3rd Wk.	Weight of Pig 4th Wk.	Weight of Pig 5th Wk.	Weight of Pig 6th Wk.
1	3.645	R1	2.725	5.525	9.410	12.375	12.275	13.875
2	3.620	L1	3.545	6.405	9.720	11.610	12.980	15.820
3	3.195	L6	1.425	3.245	5.885	7.605	8.625	10.605
4	2.905	R6	.690	2.005	3.735	5.105	5.670	7.405
6	2.340	R2	2.135	4.000	6.765	9.280	11.010	12.960
7	3.290	L5 and L6	2.635	4.625	6.915	8.525	7.920	9.320
8	3.220	L3	2.610	4.985	8.015	10.730	12.550	15.190
9	3.110	R3	2.990	5.395	8.690	10.760	12.550	15.390
10	3.050	L2	2.835	5.025	8.390	10.380	12.200	14.260
11	2.930	L4	2.625	4.795	8.140	9.735	11.560	13.885
12	2.350	R4	.990	2.320	4.300	5.785	5.600	7.050
Total Pounds	33.655		25.205	48.325	79.965	101.890	112.940	135.760

^{a/} Taken during the first six weeks, excluding birth weight.

^{b/} L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 29
Birth Weight, Teat-Nursed, and Weight^{a/} of Pigs per Week of Sow Number Six
Farrowed May 16, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Weight of Pig 1st Wk.	Weight of Pig 2nd Wk.	Weight of Pig 3rd Wk.	Weight of Pig 4th Wk.	Weight of Pig 5th Wk.	Weight of Pig 6th Wk.
1	3.305	R3	2.735	4.220	6.315	8.695	10.725	12.995
2	3.165	R2	3.165	4.825	5.870	7.985	10.200	12.610
3	2.700	L3	2.270	3.930	5.250	7.765	10.095	12.765
4	2.680	L2	2.045	2.960	5.060	7.710	9.740	12.260
5	3.130	L1	.860	1.570	2.245	3.270	4.155	4.920
6	2.900	L4	1.120	1.715	3.450	5.270	6.800	8.650
7	2.880	R4	1.850	3.190	4.580	6.030	7.440	9.270
8	2.865	R6	2.380	3.940	6.360	8.300	9.825	11.735
9	2.755	L5	1.640	2.515	3.705	4.895	6.375	7.670
10	2.690	R1	2.715	4.730	8.140	11.040	13.410	16.130
11	2.750	R5	2.645	3.605	6.160	6.380	7.825	9.165
12	<u>2.580</u>	L6	<u>2.070</u>	<u>3.550</u>	<u>6.240</u>	<u>8.180</u>	<u>9.990</u>	<u>12.020</u>
Total Pounds	34.390		25.495	40.750	63.375	85.520	106.580	130.190

a/ Taken during the first six weeks, excluding birth weight.

b/ L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 30

Birth Weight, Teat-Nursed, and Pounds of Milk Obtained^{a/} per Pig of Sow Number One
Farrowed January 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Nursed by Pig 1st Wk. ^{a/}	Milk Nursed by Pig 2nd Wk.	Milk Nursed by Pig 3rd Wk.	Milk Nursed by Pig 4th Wk.	Milk Nursed by Pig 5th Wk.	Milk Nursed by Pig 6th Wk.	Total
			----- (lb.) -----						
1	3.980	R4	0.690	0.890	0.910	0.700	0.480	0.530	4.200
2	3.850	L2	0.350	0.400	0.865	0.650	0.355	0.165	2.785
3	3.980	R5	0.400	0.610	0.935	0.790	0.445	0.240	3.420
4	3.890	R2	0.530	0.600	0.730	0.660	0.430	0.310	3.260
5	3.860	L3 & R3	0.440	0.750	0.925	0.600	0.405	0.345	3.465
6	<u>3.240</u>	R1	<u>0.510</u>	<u>0.830</u>	<u>0.880</u>	<u>0.760</u>	<u>0.485</u>	<u>0.350</u>	<u>3.815</u>
Total Pounds	22.800		2.920	4.080	5.245	4.160	2.600	1.940	20.945

^{a/} Each milk weight represents the milk obtained by a pig during six consecutive hourly nursing periods weekly.

^{b/} L1 - L7 = teats on left side, front to rear, respectively.
R1 - R7 = teats on right side, front to rear, respectively.

TABLE 31

Birth Weight, Teat-Nursed, and Pounds of Milk Obtained^{a/} per Pig of Sow Number Two
Farrowed January 22, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Nursed by Pig ^{a/} 1st Wk.	Milk Nursed by Pig 2nd Wk.	Milk Nursed by Pig 3rd Wk.	Milk Nursed by Pig 4th Wk.	Milk Nursed by Pig 5th Wk.	Milk Nursed by Pig 6th Wk.	Total
			----- (lb.) -----						
1	3.510	L1	0.530	0.500	0.290	0.440	0.460	0.485	2.705
2	3.160	R2	0.730	0.460	0.120	0.480	0.375	0.200	2.365
3	2.980	R1	0.460	0.460	0.440	0.550	0.370	0.190	2.470
4	2.650	L2	0.410	0.630	0.380	0.380	0.330	0.265	2.395
6	3.900	L3	0.350	0.460	0.560	0.620	0.510	0.225	2.725
7	3.465	L4	0.610	0.490	0.590	0.690	0.355	0.310	3.045
8	3.675	R3	0.410	0.560	0.580	0.470	0.445	0.205	2.670
9	3.170	L5	0.270	0.370	0.460	0.640	0.460	0.290	2.490
10	3.070	R4	0.490	0.500	0.610	0.760	0.350	0.275	2.985
Total Pounds	29.580		4.260	4.430	4.030	5.030	3.655	2.445	23.850

^{a/} Each milk weight represents the milk obtained by a pig during six consecutive hourly nursing periods weekly.

^{b/} L1 - L7 = teats on left side, front to rear, respectively.
R1 - R7 = teats on right side, front to rear, respectively.

TABLE 32

Birth Weight, Teat-Nursed and Pounds of Milk Obtained^{a/} per Pig of Sow Number Three
Farrowed March 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Nursed by Pig 1st Wk. ^{a/}	Milk Nursed by Pig 2nd Wk.	Milk Nursed by Pig 3rd Wk.	Milk Nursed by Pig 4th Wk.	Milk Nursed by Pig 5th Wk.	Milk Nursed by Pig 6th Wk.	Total
			----- (lb.) -----						
1	3.060	R2	0.260	0.250	0.300	0.420	0.160	0.110	1.500
2	3.210	L2	0.310	0.255	0.405	0.310	0.270	0.280	1.830
3	3.055	R3	0.185	0.230	0.360	0.340	0.270	0.370	1.755
4	2.935	R1	0.245	0.245	0.265	0.380	0.195	0.320	1.650
5	2.930	L3 and L4	0.270	0.250	0.355	0.435	0.345	0.395	2.050
6	2.500	L5 and R5	0.315	0.295	0.430	0.380	0.470	0.375	2.265
7	2.205	L1	0.195	0.260	0.235	0.270	0.240	0.280	1.480
8	<u>2.910</u>	R4	<u>0.200</u>	<u>0.210</u>	<u>0.290</u>	<u>0.335</u>	<u>0.310</u>	<u>0.320</u>	<u>1.664</u>
Total Pounds	22.805		1.980	1.995	2.640	2.870	2.260	2.450	14.195

^{a/} Each milk weight represents the milk obtained by a pig during six consecutive hourly nursing periods weekly.

^{b/} L1 - L7 = teats on left side, front to rear, respectively.
R1 - R7 = teats on right side, front to rear, respectively.

TABLE 33

Birth Weight, Teat-Nursed, and Pounds of Milk Obtained^{a/} per Pig of Sow Number Four
Farrowed March 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Nursed by Pig 1st Wk. ^{a/}	Milk Nursed by Pig 2nd Wk.	Milk Nursed by Pig 3rd Wk.	Milk Nursed by Pig 4th Wk.	Milk Nursed by Pig 5th Wk.	Milk Nursed by Pig 6th Wk.	Total
			----- (lb.) -----						
1	3.140	L3	0.270	0.340	0.350	0.250	0.290	0.185	1.685
2	3.020	R6	0.150	0.275	0.115	0.140	0.170	0.95	0.945
3	2.850	L4 and L5	0.200	0.275	0.430	0.350	0.320	0.220	1.795
4	3.190	L6	0.160	0.260	0.475	0.310	0.155	0.175	1.535
6	3.030	R4 and R5	0.135	0.330	0.305	0.270	0.290	0.165	1.495
7	2.560	R2	0.185	0.200	0.300	0.185	0.195	0.140	1.205
8	2.560	R3	0.250	0.135	0.265	0.120	0.185	0.105	1.060
9	2.640	L1 and L2	0.090	0.230	0.380	0.360	0.275	0.200	1.535
10	<u>2.350</u>	L7 and R7	<u>0.190</u>	<u>0.185</u>	<u>0.140</u>	<u>0.135</u>	<u>0.105</u>	<u>0.095</u>	<u>0.850</u>
Total Pounds	25.340		1.630	2.230	2.760	2.120	1.985	1.380	12.105

a/ Each milk weight represents the milk obtained by a pig during six consecutive hourly nursing periods weekly.

b/ L1 - L7 = teats on left side, front to rear, respectively.
R1 - R7 = teats on right side, front to rear, respectively.

TABLE 34

Birth Weight, Teat-Nursed, and Pounds of Milk Obtained ^{a/}per Pig of Sow Number Five
Farrowed May 16, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Nursed by Pig 1st Wk. ^{a/}	Milk Nursed by Pig 2nd Wk.	Milk Nursed by Pig 3rd Wk.	Milk Nursed by Pig 4th Wk.	Milk Nursed by Pig 5th Wk.	Milk Nursed by Pig 6th Wk.	Total
1	3.645	R1	0.670	0.410	0.370	0.500	0.230	0.285	2.465
2	3.620	L1	0.580	0.595	0.450	0.550	0.415	0.445	3.035
3	3.195	L6	0.360	0.385	0.455	0.305	0.240	0.155	1.900
4	2.905	R6	0.190	0.195	0.235	0.430	0.265	0.280	1.595
6	2.340	R2	0.320	0.375	0.465	0.430	0.395	0.315	2.300
7	3.290	L5 and L6	0.530	0.425	0.325	0.395	0.065	0.340	2.080
8	3.220	L3	0.420	0.565	0.205	0.515	0.445	0.350	2.500
9	3.110	R3	0.560	0.565	0.615	0.445	0.460	0.175	2.820
10	3.050	L2	0.525	0.405	0.440	0.370	0.490	0.310	2.540
11	2.930	L4	0.445	0.520	0.520	0.265	0.445	0.335	2.530
12	2.350	R4	0.210	0.210	0.235	0.305	0.595	0.190	1.745
Total Pounds	33.655		4.810	4.650	4.315	4.510	4.045	3.180	25.510

a/ Each milk weight represents the milk obtained by a pig during six consecutive hourly nursing periods weekly.

b/ L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 35

Birth Weight, Teat-Nursed, and Pounds of Milk Obtained^{a/} per Pig of Sow Number Six
Farrowed May 16, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Nursed by Pig 1st Wk. ^{a/}	Milk Nursed by Pig 2nd Wk.	Milk Nursed by Pig 3rd Wk.	Milk Nursed by Pig 4th Wk.	Milk Nursed by Pig 5th Wk.	Milk Nursed by Pig 6th Wk.	Total
1	3.305	R3	0.635	0.500	0.420	0.305	0.420	0.395	2.675
2	3.165	R2	0.490	0.300	0.370	0.380	0.395	0.470	2.395
3	2.700	L3	0.435	0.350	0.600	0.365	0.400	0.285	2.435
4	2.680	L2	0.320	0.290	0.615	0.235	0.410	0.335	2.205
5	3.130	L1	0.230	0.235	0.265	0.205	0.155	0.180	1.270
6	2.900	L4	0.180	0.115	0.170	0.170	0.205	0.195	1.035
7	2.880	R4	0.295	0.235	0.415	0.245	0.300	0.330	1.820
8	2.865	R6	0.435	0.475	0.430	0.320	0.390	0.340	2.390
9	2.755	L5	0.240	0.245	0.450	0.175	0.220	0.150	1.480
10	2.680	R1	0.625	0.520	0.495	0.510	0.495	0.530	3.175
11	2.750	R5	0.590	0.375	0.495	0.275	0.340	0.285	2.360
12	2.580	L6	0.530	0.520	0.355	0.345	0.400	0.455	2.605
Total Pounds	34.390		4.995	4.160	5.080	3.530	4.130	3.950	25.845

a/ Each milk weight represents the milk obtained by a pig during six consecutive hourly nursing periods weekly.

b/ L1 - L7 = teats on left side, front to rear, respectively.
R1 - R7 = teats on right side, front to rear, respectively.

TABLE 36

Birth Weight, Teat-Nursed by Pig, and Milk Obtained by Machine^{a/} of Sow Number One
Farrowed January 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Obtained by Machine 1st Wk. ^{a/}	Milk Obtained by Machine 2nd Wk.	Milk Obtained by Machine 3rd Wk.	Milk Obtained by Machine 4th Wk.	Milk Obtained by Machine 5th Wk.	Milk Obtained by Machine 6th Wk.	Total
1	3.980	R4	0.098	0.262	0.277	0.234	0.144	0.253	1.268
2	3.950	L2	0.084	0.182	0.187	0.132	0.250	0.175	1.010
3	3.980	R5	0.135	0.221	0.076	0.122	0.268	0.232	1.054
4	3.990	R2	0.092	0.184	0.091	0.102	0.219	0.222	0.910
5	3.960	L3 and R3	0.132	0.216	0.246	0.173	0.302	0.239	1.308
6	<u>3.240</u>	R1	<u>0.086</u>	<u>0.069</u>	<u>0.237</u>	<u>0.202</u>	<u>0.288</u>	<u>0.208</u>	<u>1.090</u>
Total Pounds	22.800		0.627	1.134	1.114	0.965	1.471	1.329	6.640

a/ The yield of milk obtained by machine at a single milking from teat(s) nursed by an individual pig.

b/ L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 37

Birth Weight, Teat-Nursed by Pig, and Milk Obtained by Machine^{a/} of Sow Number Two
Farrowed January 22, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Obtained by Machine 1st Wk. ^{a/}	Milk Obtained by Machine 2nd Wk.	Milk Obtained by Machine 3rd Wk.	Milk Obtained by Machine 4th Wk. (lb.)	Milk Obtained by Machine 5th Wk.	Milk Obtained by Machine 6th Wk.	Total
1	3.510	L1	0.116	0.139	0.099	0.130	0.122	0.145	0.751
2	3.160	R2	0.125	0.132	0.091	0.108	0.180	0.143	0.779
3	2.980	R1	0.160	0.119	0.113	0.108	0.148	0.125	0.773
4	2.650	L2	0.172	0.098	0.125	0.060	0.054	0.141	0.650
6	3.900	L3	0.033	0.175	0.154	0.167	0.010	0.158	0.697
7	3.465	L4	0.134	0.170	0.131	0.165	0.020	0.159	0.779
8	3.675	R3	0.317	0.105	0.158	0.090	0.056	0.122	0.848
9	3.170	L5	0.214	0.124	0.109	0.077	0.125	0.154	0.803
10	3.070	R4	0.114	0.043	0.137	0.160	0.226	0.198	0.878
Total Pounds	29.580		1.385	1.105	1.117	1.065	0.941	1.345	6.958

a/ The yield of milk obtained by machine at a single milking from teat(s) nursed by an individual pig.

b/ L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 38

Birth Weight, Teat-Nursed by Pig, and Milk Obtained by Machine^{a/} of Sow Number Three
Farrowed March 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Obtained by Machine 1st Wk. ^{a/}	Milk Obtained by Machine 2nd Wk.	Milk Obtained by Machine 3rd Wk.	Milk Obtained by Machine 4th Wk.	Milk Obtained by Machine 5th Wk.	Milk Obtained by Machine 6th Wk.	Total
1	3.060	R2	0.198	0.157	0.021	0.069	0.188	0.150	0.783
2	3.210	L2	0.255	0.127	0.073	0.055	0.178	0.105	0.793
3	3.055	R3	0.106	0.120	0.046	0.067	0.290	0.102	0.731
4	2.935	R1	0.245	0.101	0.012	0.067	0.129	0.086	0.649
5	2.930	L3 and L4	0.329	0.140	0.068	0.103	0.393	0.212	1.245
6	2.500	L5 and R5	0.123	0.099	0.117	0.075	0.204	0.100	0.718
7	2.205	L1	0.202	0.105	0.053	0.030	0.131	0.099	0.620
8	<u>2.910</u>	R4	<u>0.290</u>	<u>0.158</u>	<u>0.064</u>	<u>0.234</u>	<u>0.272</u>	<u>0.089</u>	<u>1.107</u>
Total Pounds	22.805		1.757	1.007	0.454	0.700	1.785	0.943	6.646

a/ The yield of milk, obtained by machine, at a single milking from teat(s) nursed by an individual pig.

b/ L1 - L7 = teats on left side, front to rear, respectively.
R1 - R7 = teats on right side, front to rear, respectively.

TABLE 39

Birth Weight, Teat-Nursed by Pig, and Milk Obtained by Machine^{a/} of Sow Number Four
Farrowed March 23, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed By Pig ^{b/}	Milk Obtained by Machine 1st Wk. ^{a/}	Milk Obtained by Machine 2nd Wk.	Milk Obtained by Machine 3rd Wk.	Milk Obtained by Machine 4th Wk.	Milk Obtained by Machine 5th Wk.	Milk Obtained by Machine 6th Wk.	Total
1	3.140	L3	0.244	0.285	0.130	0.086	0.144	0.034	0.923
2	3.020	R6	0.132	0.127	0.070	0.035	0.183	0.027	0.574
3	2.850	L4 and L5	0.121	0.200	0.216	0.149	0.248	0.107	1.041
4	3.190	L6	0.190	0.327	0.207	0.152	0.250	0.064	1.190
6	3.030	R4 and R5	0.253	0.172	0.278	0.123	0.151	0.055	1.032
7	2.560	R2	0.106	0.167	0.154	0.056	0.103	0.032	0.618
8	2.560	R3	0.250	0.153	0.145	0.091	0.115	0.034	0.788
9	2.640	L1 and L2	0.137	0.166	0.227	0.100	0.185	0.048	0.863
10	2.350	L7 and R7	0.154	0.181	0.044	0.089	0.097	0.019	0.584
Total									
Pounds	25.340		1.587	1.778	1.471	0.881	1.476	0.420	7.613

^{a/} The yield of milk obtained by machine at a single milking from teat(s) nursed by an individual pig.

^{b/} L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

TABLE 40

Birth Weight, Teat-Nursed by Pig, and Milk Obtained by Machine^{a/} of Sow Number Five
Farrowed May 16, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Obtained by Machine 1st Wk. ^{a/}	Milk Obtained by Machine 2nd Wk.	Milk Obtained by Machine 3rd Wk.	Milk Obtained by Machine 4th Wk.	Milk Obtained by Machine 5th Wk.	Milk Obtained by Machine 6th Wk.	Total
1	3.645	R1	0.135	0.268	0.144	0.167	0.150	0.075	0.939
2	3.620	L1	0.073	0.023	0.178	0.160	0.102	0.073	0.816
3	3.195	L6	0.056	0.115	0.034	0.081	0.084	0.033	0.403
4	2.905	R6	0.062	0.108	0.000	0.124	0.070	0.070	0.434
6	2.340	R2	0.105	0.150	0.071	0.134	0.140	0.058	0.658
7	3.290	L5 and L6	0.057	0.148	0.034	0.091	0.049	0.074	0.453
8	3.220	L3	0.115	0.190	0.130	0.145	0.069	0.078	0.727
9	3.110	R3	0.076	0.208	0.066	0.152	0.114	0.124	0.740
10	3.050	L2	0.100	0.186	0.066	0.140	0.110	0.076	0.678
11	2.930	L4	0.203	0.144	0.241	0.141	0.172	0.100	1.001
12	2.350	R4	0.028	0.105	0.039	0.080	0.076	0.069	0.397
Total Pounds	33.655		1.010	1.852	1.003	1.415	1.136	0.830	7.246

a/ The yield of milk, obtained by machine, at a single milking from teat(s) nursed by an individual pig.

b/ L1-L7 = teats on left side, front to rear, respectively.
R1-R7 = teats on right side, front to rear, respectively.

TABLE 41

Birth Weight, Teat-Nursed by Pig, and Milk Obtained by Machine^{a/} of Sow Number Six
Farrowed May 16, 1960

Pig No.	Birth Wt. (lb.)	Teat Nursed by Pig ^{b/}	Milk Obtained by Machine 1st Wk. ^{a/}	Milk Obtained by Machine 2nd Wk.	Milk Obtained by Machine 3rd Wk.	Milk Obtained by Machine 4th Wk.	Milk Obtained by Machine 5th Wk.	Milk Obtained by Machine 6th Wk.	Total
1	3.305	R3	0.226	0.356	0.196	0.212	0.097	0.115	1.202
2	3.165	R2	0.358	0.171	0.201	0.142	0.035	0.135	1.042
3	2.700	L3	0.192	0.158	0.194	0.158	0.114	0.112	0.928
4	2.680	L2	0.217	0.064	0.284	0.146	0.105	0.056	0.872
5	3.130	L1	0.124	0.028	0.120	0.064	0.058	0.070	0.464
6	2.900	L4	0.058	0.082	0.098	0.158	0.028	0.081	0.505
7	2.880	R4	0.211	0.110	0.134	0.094	0.024	0.117	0.690
8	2.865	R6	0.132	0.247	0.048	0.194	0.040	0.092	0.753
9	2.755	L5	0.231	0.087	0.140	0.096	0.083	0.120	0.757
10	2.680	R1	0.240	0.168	0.194	0.255	0.106	0.107	1.070
11	2.750	R5	0.098	0.155	0.047	0.096	0.058	0.052	0.506
12	2.580	L6	0.104	0.128	0.094	0.196	0.025	0.041	0.588
Total Pounds	34.390		2.191	1.754	1.750	1.811	0.773	1.098	9.377

a/ The yield of milk obtained by machine at a single milking from teat(s), nursed by an individual pig.

b/ L1 - L7 = teats on left side, front to rear, respectively.

R1 - R7 = teats on right side, front to rear, respectively.

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AUTOBIOGRAPHY

I, Dennis August Hartman, was born in Florence, Missouri, May 3, 1931. I received my primary-school education in the public school of Florence, Missouri, my secondary-school education in the public school of Stover, Missouri, and my undergraduate training at the University of Missouri, Columbia, Missouri, which granted me the Bachelor of Science degree in 1955. I received the Master of Science degree from the same University in 1956. While in residence for this degree, I was appointed Graduate Research Assistant in the Department of Dairy Science. In July, 1956, I joined the Animal Husbandry Extension Staff of the New York State College of Agriculture at Cornell University, Ithaca, New York. I have been employed there while completing the requirements for the degree Doctor of Philosophy.