A Comparison of the Effects of Hand Mating and Lot Mating on the Reproductive Performance of Gilts

E. J. Turman, J. C. Hillier, Allen Sharp, Jerry Lawrence and James Tilton

The most important single factor affecting the gross returns to a swine enterprise is number of pigs weaned per litter. This, in turn, is a function of: number of eggs ovulated; fertilization rate; embryo survival during gestation; and survival of pigs after farrowing. Any improvement in breeding, feeding or management that will result in an increase in any of these items will improve litter size at weaning.

It is well known that the number of eggs ovulated at a given heat period varies greatly among gilts. Among the factors that have been demonstrated to have a great influence on this item of reproductive performance are: (1) breed, (2) age of gilt, and (3) level of feeding. It has also been suggested, from results with laboratory animals, that the presence of the male, just prior to and during heat, may stimulate a higher ovulation rate.

The results reported in the past from other stations indicate that a low fertilization rate is not a major factor affecting litter size. Their results have shown that in the vast majority of the sows and gilts that settle to a particular mating, 95 percent or more of the eggs ovulated are fertilized. Almost all of the difference between numbers of eggs ovulated and numbers of pigs born is the result of embryonic mortality, that is death of the fertilized egg sometime during gestation, rather than being the result of an ovulated egg failing to be fertilized.

Embryonic death loss is probably the major factor reducing litter size in swine. It has been estimated that, even under the best of management, 25 percent to 40 percent of the fertilized eggs die during gestation. Under unfavorable conditions of management and/or environment this loss may be even larger. Two important factors that have been shown to increase the incidence of embryonic death loss are high levels of feeding after breeding, and exposure to high temperature. Undoubtedly, many other factors also affect embryo survival to the extent that one might make the general statement that any unfavorable condition that places some kind of a stress on the pregnant female will be detrimental to embryo survival. What still needs to be determined is the stage, or stages, of gestation when the pregnant female is most susceptible to stress.

The most common system of breeding practiced by swine producers is to pen mate sows and gilts by running one or more boars with a group of females. Certainly it reduces labor requirements and should result in all females being bred as early as possible in the breeding period in contrast to an occasional hand mated gilt being delayed for one cycle because of difficulty of heat detection. However, little is

known of the effect, if any, that system of mating may have on the subsequent litter size. Certainly the frequent harrassment by the boar of a gilt during heat represents a form of stress occurring very early in gestation. This is a progress report of a research study now underway which was undertaken in an effort to determine the effect of hand mating vs. pen mating on ovulation rate, conception rate, and embryo survival of gilts.

Procedure

This study involved 60 gilts between the ages of 8 and 13 months. A total of three trials were conducted in the period from August, 1964, through April, 1965. With the exception of two Hampshire gilts used in Trial 2, all gilts were Yorkshires. All gilts on the same treatment in each trial ran together in the same lot, but were individually fed a 14 percent protein ration. The gilts were weighed at 14-day intervals and just prior to slaughter.

Two treatments were imposed in each trial. One group of 10 gilts was hand mated once each day they were observed to be in heat. The herdsman checked the lot each morning, and any gilt believed to be in heat was transferred to a breeding chute adjacent to the pen. The boar was allowed to serve the gilt and she was then returned to the lot. She was rechecked each morning thereafter until she refused to stand for service. The other group of gilts was lot mated, with boars rotated either twice or three times daily to insure that a fresh boar ran with the gilts at all times. No limit was placed on the number of services permitted each gilt. The lot was checked frequently to obtain breeding dates. A total of eight yearling Yorkshire boars were used. They were rotated daily in an effort to have each boar mated to an equal number of gilts on each treatment.

In allotment to treatment an effort was made to assign littermate gilts to different treatments. Otherwise allotment was on the basis of body weight. The two lots of gilts were not kept adjacent to each other but were separated by a lot in which no boars were kept. This precaution was taken to prevent close contact between the gilts in the hand mated lot with boars except at time of breeding.

The gilts were slaughtered in a local packing house and the entire reproductive tract recovered for study. In Trial 1 they were slaughtered as near to 35 days after breeding as possible, and in Trials 2 and 3 as close to 30 days post breeding as possible. Since slaughter was confined to one day per week the range in time of slaughter in Trial 1 was 34-41 days, and in Trials 2 and 3, 28-36 days post-breeding. The following observations were made 2 to 5 hours after slaughter on the reproductive tracts: (1) number of corpora lutea on each ovary; (2) number of apparently normal embryos in each uterine horn, and (3) number of dead or degenerating embryos in each horn. Each uterine horn was opened completely and all embryos were carefully examined. Any embryo that was grossly abnormal was classified as dead.

Trial 1: 20 Yorkshire gilts were allotted equally between the two treatment groups on August 10, 1964. The average age and weight of the gilts of the two lots were: hand mated, 249 days and 287 lbs., and lot mated, 252 days and 287 lbs. The first gilt was bred on September 2, 1964, and the last recorded mating was November 12, 1964. For the duration of this trial the daily feed allotment was 4½ lbs. per gilt. Fresh boars were rotated into the lot mated pen at 8:00 a.m. and 5:00 p.m. One gilt in the lot mated group died during the course of the experiment.

Trial 2: 18 Yorkshire and 2 Hampshire gilts were allotted equally between the two treatments on November 14, 1964. The average age and weight of the gilts of the two lots were: hand mated, 285 days and 293 lbs., and lot mated, 284 days and 284 lbs. The first recorded mating was on December 12, 1964, and the last on January 7, 1965. The gilts were started on 5 lbs. of the mixed ration per head per day, then "flushed" by raising the level to 7 lbs. per day 2 weeks before breeding was to start. As soon as a gilt was bred her feed level was dropped again to 5 lb. per day. Boars were rotated in the lot mated group three times daily, at 8:00 a.m., 1:00 p.m., and 5:00 p.m.

Trial 3: 20 Yorkshire gilts were allotted equally between the two treatments on December 22, 1964. The average age and weight of the gilts placed on each treatment were: hand mated, 306 days and 286 lbs., and lot mated, 302 days and 294 lbs. The first recorded mating was February 22, 1965, and the last mating occurred on March 13, 1965. The gilts were started on 5½ lbs. of feed per head per day, "flushed", starting 2 weeks before first expected breeding, by raising the feed level to 8 lbs. per head per day, then dropped on an individual basis, to 5½ lbs. per day at the time they were bred. Boars were rotated into the pen mated lot on the same schedule as in Trial 2. An additional stress was imposed on the gilts in the lot mated group. Beginning the day after the last day of heat each gilt was placed in the boar lot for 5 minutes on each of 5 consecutive days. During this 5-minute period the boars were permitted to run the gilt at will. One gilt in the lot mated group aborted, therefore, data was available on only 9 gilts in this lot.

Results and Discussion

Ovulation Rate:

In the interval between the twenty-fourth and fortieth hour after the start of heat the sow releases eggs from the ovary in the process of ovulation. The number of eggs released varies from a very few to as many as 30, with most gilts ovulating from 10-18. Obviously, ovulation rate, that is the number of eggs shed, is the first of several limiting factors affecting subsequent litter size.

At each place on the ovary where an egg is released, a structure called the corpus luteum forms. If the gilt is bred and conceives, these structures remain in the ovary for the duration of gestation. It is not the

purpose of this paper to discuss their physiological function, but they are mentioned to point out the means available to determine the number of eggs ovulated at a heat period that occurred 30-40 days earlier. It is a simple matter to count the number of corpora lutea and know that they represent the number of potential embryos that could be in the uterus.

The gilts used in this study had an excellent ovulation rate. The data presented in Table 1 shows that 60 percent of the hand mated and 60.7 percent of the lot mated gilts ovulated 17 or more eggs. Just under 15 percent of each group ovulated 20 or more eggs, with one gilt ovulating 23. Only 3.3 percent of the hand mated and none of the lot mated gilts, ovulated 10 or fewer eggs. It is likely that the breed used and, as will be discussed later, the age of the gilts used and the system of feeding had much to do with obtaining this excellent prolificacy.

The data presented in Table 2 reveals that there was a small increase in ovulation rate in the gilts that were lot mated when compared to those hand mated. The average increase for all trials was 0.6 egg, with the range by trials being from no difference observed in Trial 2 to an increase of 1.0 egg in Trial 1. When analyzed statistically this difference was not significant.

There were marked differences between trials in ovulation rate. The average rate of all gilts in Trial 1 was 14.9 eggs, and the average weight and age of the gilts at time of breeding was 297 days and 310 lbs. The gilts used in Trial 2 were 24 days older, although weighing only 1 lb. more on the average than the gilts used in Trial 1. The average ovulation rate of the gilts in Trial 2 was 17.1 eggs, an increase of 2.2 eggs per gilt over Trial 1. The gilts in Trial 3 averaged 54 days older and 35 lbs. heavier than the gilts in Trial 2, and ovulated an average of 18.7 eggs per gilt, an increase of 1.6 eggs per gilt over the average for gilts of Trial 2.

It is likely that two factors account for most of the difference in ovulation rate between gilts of Trial 1 and Trial 2. One is the increased age of the gilts, and the second is the change that was made in feeding management. The gilts of Trial 1 were fed a constant level of feed throughout the trial. The gilts of Trial 2 were "flushed" by having their feed level increased from 5 to 7 lbs. per gilt for at least 2 weeks prior to breeding. The beneficial effect on ovulation rate of increasing the

Table 1. Ovulation Rate of the Gilts Used in this Study.

No. of Eggs	Treatment			
	Hand Mated		Lot Mated	
	Number	Percent	Number	Percent
20 or more	4	13.3	4	14.3
17 — 19	14	46.7	13	46.4
14 — 16	8	26.7	9	32.1
11 — 13	3	10.0	2	7.2
10 or less	1	3.3	0	0.0

Table 2. The Effect of Hand Mating vs. Lot Mating of Gilts on Ovulation Rate and Survival of Embryos 30-40 Days Post-Breeding.

Item	No. Gilts	Breeding Age	Breeding Weight	No. Eggs	No. Embryos	Percent Embryo Survival
		(days)	(lb.)			(Percent)
Trial 1.						
Hand Mated	10	307.8	320.0	14.4	11.5	79.9
Lot Mated	9	281.1	296.1	15.4	10.6	68.3
Trial 2.						
Hand Mated	10	320.2	317.8	17.1	14.0	81.9
Lot Mated	10	322.0	304.3	17.1	12.0	70.2
Trial 3.						
Hand Mated	10	378.4	348.9	18.4	15.4	83.7
Lot Mated	9	371.3	343.1	19.0	12.8	67.3
All Trials.						
Hand Mated	30	335.4	328.9	16.6	13.6	82.0
Lot Mated	28	328.1	315.5	17.2	11.8	68.6

feed level just prior to breeding has been demonstrated by other researchers. Although a comparison of flushed and non-flushed gilts was not made in the same trial in this study, the results indicated that flushing is a beneficial practice. It is also important to remember that since the gilts were individually fed, all gilts received the flushing level of feed. Had they been group fed it is likely that some would have eaten more than their share, thus depriving other gilts of the beneficial effects of flushing.

The data presented in Table 3 indicates that the age of the gilts had an important effect on ovulation rate. Data for all three trials were combined for all gilts on each treatment and divided into 3 groups according to the age of the gilts. The oldest one-third of the gilts in each treatment group averaged 44 days older than the middle one-third, which in turn, were approximately 42 days older than the youngest one-third of the gilts. The differences in ovulation rate were: for the hand mated group, an increase of 1.3 eggs between the youngest and middle age groups, and an increase of 1.0 egg between the middle and oldest groups; for the lot mated group, an increase of 0.9 egg between the youngest and middle group, and an increase of 1.4 eggs between the middle and oldest groups. For all practical purposes, each 6 weeks increase in age of the gilts used in this trial was accompanied by an increase of 1.0 egg in ovulation rate.

Other researchers have also reported that ovulation rate increases with increasing age in gilts. Most of their studies were based on observations made on younger gilts, comparing ovulation rates at the first, second and third heat periods of the gilt. The heat period after attainment of sexual maturity on which the gilts used in this study were bred was not known, but the results indicate there is a continuing increase in ovulation rate with increasing age of gilts at least to one year of age.

Table 4 presents the relationship between weight of the gilt and ovulation rate. While the differences are not as marked in the hand

Table 3. Effect of Age of Gilt at Time of Breding on Ovulation Rate and Survival of Embryos 30-40 Days Post-Breeding

Item	No. Gilts	Average Wt.	No. Eggs	No. Embryos	Percent Survival
Hand Mated					
Oldest ⅓	10	378.9	18.3	15.4	84.2
Middle ⅓	10	334.9	17.3	12.6	72.8
Youngest ⅓	10	293.6	16.0	13.8	86.3
Lot Mated					
Oldest ⅓	9	371.3	19.0	12.8	67.3
Middle ⅓	9	327.3	17.6	11.7	66.5
Youngest ⅓	9	285.7	15.7	11.6	73.8

mated group, the results in the lot mated group are very similar to those observed when grouping was based on age. This should be expected since the older gilts should be the heavier gilts. This was true to a large extent in the lot mated group since the fraction of the gilts that was in the same third, either top, middle or lowest, on both age and weight were: top one-third, 7 of 9; middle one-third, 6 of 9; and lowest one-third, 7 of 9. In the hand mated group the fraction in the same group on both age and weight was: top one-third, 5 of 10; middle one-third, 3 of 10; and bottom one-third, 7 of 10. This discrepancy between the allotments based on age and those based on weight in the hand mated group probably explains the relationship observed between weight and ovulation rate in the gilts on this treatment.

The results obtained in this study suggest that the producer could increase ovulation rate by breeding the older, heavier gilts of a group first. If ages are not known, selection based on weight of the gilts should also be effective. Certainly, it appears wise to delay breeding the younger, smaller gilts as long as possible.

The results of this study indicate that the presence of a boar in a pen of gilts has little, if any, stimulatory effect on ovulation rate. The most apparent advantage of this system of breeding is one of reduced labor requirements at breeding time, and eliminating human errors of heat detection.

Duration of Heat: An accurate measure of duration of heat was not obtained in this study since the hand mated gilts were checked only once daily. It was not determined just when heat ended in the period between the last acceptance and first refusal of the boar. The data based on days observed in heat is presented in Table 5. Of the 57 gilts for which heat dates were obtained in this study, 24 (42 percent) were in heat one day, 23 (40 percent) were in heat 2 days, and 10 (18 percent) were in heat 3 days. No gilts were in heat longer than 3 days. The average duration of heat in the gilts of the hand mated group was 1.8 days, with 67 percent in heat 2 days or longer. The average duration of heat in the lot mated group was 1.67 days, with 48 percent in heat 2 days or longer. The same number of gilts on each treatment (5) were in heat for 3 days.

Table 4. Effect of Weight of Gilt at Time of Breeding on Ovulation Rate and Survival of Embryos 30-40 Days Post-Breeding

Item	No. Gilts	Average Wt.	No. Eggs	No. Embryos	Percent Survival
Hand Mated					
Heaviest ⅓	10	363.6	18.0	15.0	83.3
Middle ⅓	10	326.9	16.7	11.6	69.5
Lightest ⅓	10	295.0	16.7	13.7	82.0
Lot Mated					
Heaviest ⅓	9	347.7	18.6	13.3	71.9
Middle ⅓	9	311.9	17.2	11.2	65.2
Lightest ⅓	9	288.8	16.0	11.7	72.9

Table 5. Duration of Heat in Hand Mated and Lot Mated Gilts.

Days Observed in Heat	Number of Gilts Observed in Heat							
	Hand Mated				Lot Mated			
	Trial 1	Trial 2	Trial 3	All Trials	Trial 1	Trial 2	Trial 3	All Trials
1	5	4	1	10	5	6	3	14
2	4	6	5	15	0	3	5	8
3	1	0	4	5	2	1	2	5

Conception Rate:

The conception rate obtained in this study was very good. Of the 57 gilts for which a mating was observed, 53 (93 percent) conceived at the first heat period they were bred. There were 2 gilts in each treatment group failing to conceive at first heat, but all conceived at the next heat period.

Embryo Survival:

Research studies conducted in the past at other experiment stations have indicated that almost all of the embryonic mortality that occurs during the 114 days of gestation occurs within the first 30-35 days. If this is true, and it is based on good evidence, the number of live embryos present at 30-35 days gives a good estimate of what litter size would have been had the gilts been carried to term and farrowed. By using data obtained by slaughtering at 30-35 days rather than farrowing the gilts, research studies can be speeded up considerably and data can be obtained on a larger number of gilts. Perhaps the results and discussion that follows will be much more meaningful if they are regarded in terms of being an accurate measure of litter size had the gilts been allowed to farrow.

The most important difference observed in the gilts on the two treatments was in embryo survival. As shown in Table 2, there was an advantage in all trials in favor of the hand mated group. The average embryonic survival rate for each treatment, when all trials were combined, was 82.8 percent for the 30 hand mated gilts, and 68.6 percent for the 28 gilts that were lot mated, an average difference of 13.4 per-

cent. The differences in favor of the hand mated gilts for each trial were; 11.6 percent in Trial 1, 11.7 percent in Trial 2 and 16.4 percent in Trial 3.

The economic value of this difference in embryo survival is best shown by comparing actual numbers of embryos. At the time of slaughter 30 to 40 days after breeding, there was an average of 1.8 more living embryos in the hand mated gilts. A similar difference was observed in every trial with the hand mated gilts exceeding the lot mated gilts by 0.9 embryos in Trial 1, 2.0 embryos in Trial 2 and 2.6 embryos in Trial 3. These differences were statistically highly significant.

It was not possible from the data obtained in this study to determine with certainty either when or why this difference occurred. Studies are now underway to attempt to determine whether it is the result of reduced fertilization rate or early embryonic death, or a combination of both. The best explanation as to the cause would appear to be the added stress of repeated harrassment of the gilts by the boars running with the lot mated gilts. This is given support by the results obtained in Trial 3 in which the gilts were placed in the boar lot for 5 minutes on each of the first 5 days after the last day of heat. The largest difference between treatments in both number of embryos and percent survival was observed in the gilts in this trial and they were the gilts that should have been under the greatest stress during and soon after heat.

Season apparently had no or little effect on embryo survival in this study since the average survival for all gilts in each trial varied very little among the three trials. These averages were: Trial 1, 74.2 percent; Trial 2, 76.0 percent; and Trial 3, 75.8 percent. It must be considered, however, that in no trial was breeding carried out during the summer. It is tempting to speculate that even wider differences would have occurred had this been done.

There was no consistent difference in embryo survival associated with age of the gilts at time of breeding (Table 3). In the hand mated group, survival is comparable in the oldest and youngest groups, but much lower in the middle one-third. In the lot mated group the best survival occurred in the youngest group, with the middle and oldest groups approximately the same.

When the embryo survival of gilts of different weights are compared (Table 4) there is a similar pattern in both treatments. The heaviest and the lightest groups have comparable survival, and both are definitely superior to the middle weight group.

The effect on embryo survival associated with age and weight of gilt at breeding is not clear cut. Just what importance to place on it, if any, is not known. The differences do not give any reason for changing the recommendation that if a producer plans to breed only a part of his gilts during a given season he should pick the older, heavier gilts. The advantage in favor of the oldest gilts over the youngest gilts in number

of embryos was 1.6 embryos in the hand mated and 1.2 embryos in the lot mated group. This advantage was observed even though the youngest group had a slightly higher survival rate. The advantage in favor of the heaviest one-third compared to the lightest one-third of the gilts was 1.3 embryos in the hand mated and 1.6 embryos in the lot mated group.

The economic importance of level of embryonic death loss and its subsequent expression in litter size is very evident in the data presented in Table 3. The middle one-third of the hand mated group averaged ovulating 1.3 eggs more than did the youngest one-third, yet, because of a much higher rate of mortality, had 1.2 fewer embryos. In the lot mated group the middle group on age averaged 1.9 more eggs than did the youngest group, but lost almost all of this advantage because of a higher mortality rate resulting in an advantage of only 0.1 embryo at time of slaughter.

The results obtained in this study appear to justify reaching a rather general conclusion. The most logical reason for the poorer embryo survival in the lot mated gilts was the increased stress placed on these gilts at an apparently critical time. This suggests that the swine producer should critically examine his program to determine whether conditions of stress are being placed on gilts at, or near, time of breeding. It would appear that every effort should be made to eliminate all but the most necessary handling or disturbing of gilts during, and for several weeks following, breeding.

Summary

There were small differences in the performance of hand mated and lot mated gilts in ovulation rate, length of heat and conception rate. There were highly significant differences in each of 3 trials in favor of the hand mated gilts in embryo survival for 30-40 days after breeding. The average survival rate for all trials for 30 hand mated gilts was 82.8 percent compared to 68.6 percent for 28 lot mated gilts. On the average the hand mated gilts had 1.8 more live embryos than did the lot mated gilts.

There was a consistent increase in ovulation rate with increasing age of the gilts. In the gilts in this study, ranging in age from approximately 8 to 12 months of age, each increase of 6 weeks in age was accompanied by an increase of 1.0 egg in ovulation rate.