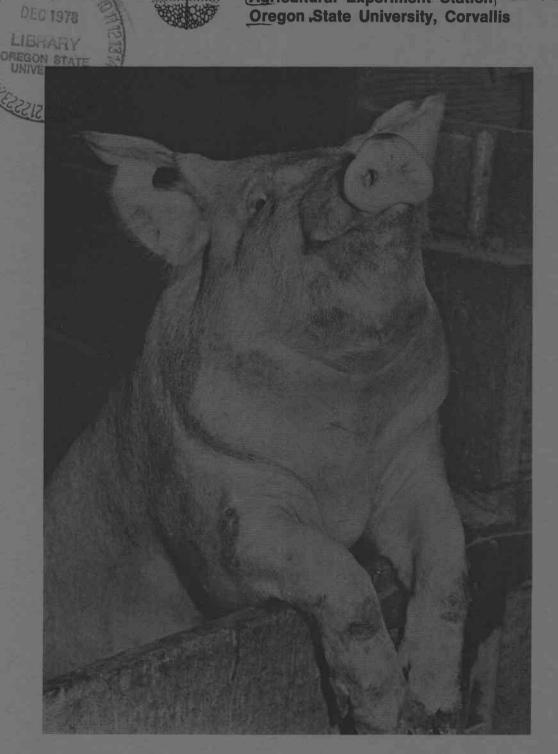
REPORTS OF THE 19th ANNUAL

SWINE DAY

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The staff of permanent herdsmen and part time student employees at the Swine Center contribute to the accomplishments of all production research through their specific and general care and management activities. Current herdsmen at the Swine Center are: Roy Fancher, Earl Bishop and Mark Uhden. Dr. Walter H. Kennick and Edwin Barrett contribute to all carcass research through their general and specific activities at the OSU Clark Meat Science Laboratory. Current graduate students conducting thesis research with swine are: Dennis Bel Isle, Stewart Floyd, Brad LeaMaster, Ronald Matheny, Bruce Moos, John Powley, Calvin Schiemann and Calvin Walker. Current resident undergraduate student employees at the Swine Center are Polly Yett, Margaret Melvin and Jane Sowden.

Appreciation is expressed to the Withycombe Club and Clark Meat Science Laboratory personnel for preparation and serving of the roasted market hog and other items of the lunch menu.

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SYSTEMS OF CROSSBREEDING FOR COMMERCIAL SWINE PRODUCTION David C. England 1

The purebred and crossbred segments of the swine industry are mutually interdependent. The crossbred segment depends on purebred breeders to provide two important services: (1) continued genetic improvement in performance merit for litter productivity, growth rate, feed efficiency, carcass merit, and freedom from inherited defects; and, (2) availability of boars which will consistently transmit to their offspring in a crossbreeding program the genetic ability for superior performance in these traits. The purebred breeder in turn depends on the commercial crossbreeding industry to regularly purchase, at a price which covers costs and allows for a reasonable profit, the boars that are needed for continued improvement of efficiency in the commercial swine production industry.

In a sense, the purebred industry is a provider and the commercial industry is a user. Their needs are the same—highest performance and quality; but several aspects of reaching these goals are different; this is especially true of the mating systems used. The goal of the purebred breeder's mating system is to accomplish three things: (1) to keep from dissipating the quality of performance already achieved through selection; (2) to acquire additional sources of genetic capability through introduction of performance or progeny tested animals; and (3) to thoroughly incorporate the added genetic material into the herd through the mating system and selection program in such fashion that transmission of superior performance capability to offspring in commercial herds will be consistent and can be accurately predicted on the basis of purebred level of performance.

The major genetic goals of the crossbreeder's mating system are: (1) achieving and maintaining highest genetic capacity for performance and quality; (2) achieving and maintaining highest levels of hybrid vigor in each sow and litter.

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To achieve these goals requires a continuous availability of boars developed to specifically meet these needs.

The important role of sires in both purebred and crossbred breeding is illustrated by the following listing of the cumulative percentages of heredity contributed by boars in herds in which all replacement females are selected from within the herd and new sires are added each generation. The percnetages designated by * are derived from previously used sires through selection of replacement dams from within the herd (table 1).

TABLE 1. PERCENT OF HEREDITY IN EACH GENERATION AND CUMULATIVE PERCENTAGE DERIVED FROM SIRES USED IN A HERD

| | 50 75 |
|----|----------|
| | 75 |
| | 13 |
| | 87 1/2 |
| 50 | 93 3/4 |
| | 50 |

Crossbreeding systems are widely used in swine production. Basically, cross-breeding systems are of two kinds: (1) repetitive, or (2) continuous. Repetitive crossbreeding systems repeat the total crossbreeding scheme, including use of purebred dams, after a specified sequence of mating. Continuous crossbreeding systems select crossbred replacement females from each generation of progeny and proceed indefinitely without use of purebred females.

The use of crossbred dams improves litter production in four ways: (1) crossbred gilts reach puberty at younger ages; (2) crossbred females ovulate more eggs; (3) crossbred females maintain a higher percentage of embryos throughout gestation to be farrowed as live pigs; and, (4) crossbred dams wean a higher percentage of pigs born alive. In addition, crossbred fetuses have a superior ability to survive prenatally; crossbred dams inevitably produce crossbred pigs regardless of the system of crossbreeding used.

The starting point of all crossbreeding systems is a cross of two breeds; from this mating, F₁ progeny can all be sold, or some of the females can be retained for brood stock. If all progeny are sold and crosses of the purebreds are used repeatedly, the system is known as a <u>single cross</u>. This system produces fully crossbred pigs, but does not provide or utilize any of the advantages of hybrid vigor in dams. Furthermore, the system itself does not provide a source of replacement gilts; these can be obtained by making some purebred matings instead of crossbred matings when replacements are needed, or by purchase of purebred females, but both of these methods are outside of the crossbreeding system itself.

If the crossbred females are selected for use as dams, they can be used as a part of each of the three remaining systems: (1) terminal cross; (2) crisscross; or (3) rotational cross.

In the terminal cross system, the AxB crossbred females are mated to boars of purebred breed C; all offspring of these matings are marketed. When replacement females are needed, it is necessary to make the AxB single cross again; thus this system is not self-sustaining without resorting to use of purebreds which are not produced in the system. Any three breeds can be used in a terminal cross program but generally A and B are breeds with superior maternal productivity—prolificacy, temperament, milk production, and number and size of pigs weaned; breed C, used as sires, is generally chosen for superiority of performance in market hog traits—post—weaning growth rate, feed efficiency, and carcass merit. In a terminal cross system, the crossbred dams and their crossbred offspring are fully crossbred and thus exhibit as much hybrid vigor as can be obtained; the relative merit of this repetitive cross vs. either of the continuous crosses depends largely on whether the differences in maternal traits and "market hog" traits are present separately in different breeds to such an extent that better

crossbred combinations can be achieved by the use of three breeds in this fashion than by the same or other three breeds in a rotation cross. For maximum advantage, the sire breed would need marked superiority over levels attainable in the dam breeds in one or more of the market hog traits, and conversely, the breeds used to produce the \mathbf{F}_1 crossbred dams must possess productivity for litter traits at levels higher than attainable in the sire breed. Reseach has not fully established to what extent these situations exist among commonly used breeds of swine.

The crisscross system uses boars of breeds A and B in alternate generations to mate crossbred females produced in the previous generation. This system is simple to use; it need only be known whether breed A or breed B was the sire of any female so that she can be mated to a boar of the other. This system, to an extent, does all of the things a crossbreeding system should do: it (1) uses crossbred dams; (2) it produces crossbred offspring; (3) it provides replacement females; and (4) it allows for crossing breeds which complement, or "cover up", the inadequacies of each other. Its major shortcomings are two: (1) it does not provide full crossbreeding in either the dam or offspring after the first generation (table 2); and (2) it does not keep the inadequacies covered up completely after the first generation of crossing is completed.

TABLE 2. PERCENT HEREDITY IN OFFSPIRNG FROM EACH BREED OF SIRE USED IN SEVERAL GENERATIONS OF A CRISSCROSS PROGRAM

| Offspring Generation | Breed of sire | | Hered. | % same breed hered. from dam | Total sire breed hered. | % crossbred |
|-------------------------|------------------|---------------|--------|------------------------------|-------------------------|----------------|
| 1 . | A | В | 50 | 0 | 50. | 100 |
| 2 | A | AxB | 50 | 25 | 75 | 50 |
| 3 | В | Ax (AxB) | 50 | 12 1/2 | 62 1/2 | 75 |
| 4 | A | Bx(Ax(AxB) | 50 | 18 3/4 | 68 3/4 | 62 1/2 |
| 5 | В | Ax(Bx(Ax(AxB) | 50 | 15 5/8 | 65 5/8 | 68 3/4 |

The rotation cross removes most of the inadequacies of the crisscross system.

As can be seen in table 3, it approaches full crossbreeding of both dams and

offspring. Further, there can be better "cover up" of inadequacies of each breed; it is possible to make choice of breeds and individuals so that no trait is inadequately represented by more than one of the three breeds.

TABLE 3. PERCENT HEREDITY IN OFFSPRING FROM EACH BREED OF SIRE USED IN SEVERAL GENERATIONS OF A ROTATIONAL CROSS PROGRAM

| Offspring Generation | Breed of sir | | % Hered. from sire | % same breed hered. from dam | Total sire breed hered. | % crossbred |
|-------------------------|-----------------|-----------------|-----------------------|------------------------------|-------------------------|----------------|
| 1 | A | В | 50 | 0 | 50 | 100 |
| 2 | С | AxB | 50 | 0 | 50 | 100 |
| 3 | A | Cx(AxB) | 50 | 12 1/2 | 62 1/2 | 75 |
| 4 | В | Ax (Cx (AxB) | 50 | 6 1/4 | 56 1/4 | 87 1/2 |
| 5 | С | Bx (Ax (Cx (AxB |) 50 | 6 1/4 | 56 1/4 | 87 1/2 |

Two principles are of paramount importance in securing highest levels of performance in crossbreeding: (1) use of breeds and individuals which have highest levels of production; this provides a high level of purebred capability above which hybrid vigor will add additional productivity; and, (2) use of a system which maximizes the amount of crossbreeding in both dams and offspring. A third principle of considerable importance is to use breeds which complement each other; in each generation, sires should be strong in production traits in which dams are least adequate.

The importance of maintaining full crossbreeding is sometimes overlooked. A fully crossbred animal contains no more than 50% of its heredity from any breed. As can be seen in table 2, pigs and dams in the crisscross system, after a few generations, derive about 67% of their heredity from the breed of their sire; this is true because 50% of their heredity comes from their sire, and their dams also contain heredity from that breed. Thus, in the crisscross system, animals are only about two-thirds crossbred--or about 33% non-crossbred. In the rotation cross, (table 3) about 56% of the heredity of offspring is obtained from the breed of sire in each generation after the first few; these animals are about 88% cross-

bred, or only 12% <u>non-crossbred</u>. If three breeds can be obtained that are of productive merit equal to that of two breeds it is, because of the increased crossbreeding that results, to be expected that three breeds will produce higher levels of crossbred performance because of the larger amount of crossbreeding involved. Use of four breeds reduces the amount of non-crossbreeding only to about 9%. The use of four breeds instead of three has much less added crossbreeding effect than does changing from a two-breed to a three-breed cross.

It is important that boar breeds be used in proper sequence in continuous crossbreeding systems; failure to do so reduces the amount of crossbreeding involved. For example, if boars of breed C are used to sire generation 4 offspring in the totation cross illustrated in table 3, the percent of heredity from the breed of sire (C) will be 62 1/2% instead of 56 1/4%--this is an increase of 6 1/4% in the proportion of heredity obtained from one breed; this amounts to approximately a 12 1/2% decrease in the amount of heterosis expected on the basis of genetic unlikeness of the parents. Failure to allot sows to boars on the basis of their sire background reduces the heterosis in their offspring and as dams if these females are kept as replacement gilts. Because many aspects of environment, as well as the mating systems used, affect litter size, the lower average litter size resulting from failure to follow the system thoroughly may not be readily noticed. Research indicates that it indeed occurs. One report (England, 1952) shows an average heterosis of 13.2% for a properly designed and followed rotational crossing program and only 8.6% for a rotation cross which lacked full genetic unrelatedness.

Table 1 illustrates the role which boars have in maintaining the genetic quality of either purebred or crossbred herds. As can be seen, boars become the predominant influence on herd genetic quality; this is equally true in purebred and crossbred herds. From this table conclusions can readily be drawn: (1) continual use of genetically superior boars will maintain genetic quality of either purebred or crossbred herds; and (2) if boars of different breeds are used in each

generation, the only non-crossbreeding that will exist in the offspring is due to the extent to which dams contain heredity from the same breed source as the boars to which they are mated.

It is the responsibility and opportunity of the purebred industry to develop boars of high production merit for use by the commercial crossbred industry. Hybrid boars can be used equally successfully, but only if the overall development of the hybrids and the program of their use is knowledgeably developed and followed. Unless a specifically planned program of both development of the hybrids and their use as sires in a crossbreeding program is followed, increased relationship between sires and dams is likely to occur. In addition, it is likely that increased genetic variability will occur in the offspring unless specific developmental and usage programs are followed.

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CHARACTERISTICS OF NEWBORN PIGS THAT INFLUENCE THEIR SURVIVAL

Keith W. Kelley

INTRODUCTION

Why save baby pigs?

Fifteen to thirty percent of all liveborn piglets die before weaning.

Nearly half of these deaths occur during the first few days of life (Figure 1;

Bereskin et al., 1973; Edwards, 1972; Fahmy and Bernard, 1971; Hartsock et al.,

1977). This amounts to nearly 2 pigs lost per litter. If this mortality could be reduced by only one-half, pork producers would gain an extra litter of pigs for every 10 sows farrowed. To view these losses in a different perspective, assume that a piglet is worth \$12 at birth and a producer farrows 240 litters per year. Death loss of pigs before weaning cost this pork producer nearly \$500 per month. In addition to these acute losses, neonatal morbidity is also costly.

Better feed efficiency.

Saving baby pigs is also a very effective means of improving feed efficiency of the herd. For instance, a recent Missouri study (National Hog Farmer, 1977) of 26 hog farms revealed that less than 11 pigs were marketed per sow per year. Nearly 2.5 pigs per litter died between birth and 8 weeks of age. If farrowing house management were improved such that only 4 more pigs were saved yearly, this would result in 15 market hogs from each sow per year. Assuming a sow consumes 1000 kg of feed per year, 91 kg of sow feed are charged to each pig from the dam that raises only 11 market pigs yearly. With the sow that raises 15 pigs per year, each pig is charged with 67 kg of sow feed. The result is that each pig from the smaller litter is charged with 24 kg more sow feed at market time. In terms of economics, this represents nearly a \$3.50 savings in sow feed

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costs for each pig marketed from the larger litter. Other fixed sow costs, such as housing and equipment, would also be prorated over more pigs per litter.

DISCUSSION

Why do baby pigs die?

In order to save more baby pigs, swine producers must improve management in the farrowing house. England (1974) pointed out that 50 percent of the preweaning losses occur in piglets weighing less than 910 g at birth. Since heritability of birth weight is practically nill, a reduction in neonatal mortality must be achieved by improving husbandry practices for the small, weak piglets during the first few days of life.

There are several causes of baby pig mortality. Most studies cite starvation, chilling, overlay by the sow, innate weakness and infection. A recent study at Washington State University has characterized several parameters related to neonatal mortality (Table 1). As expected, piglets that were born alive but died before 21 days of age weighed less than piglets that survived. Surviving piglets were also born earlier in the litter.

Earlier-born piglets are heavier.

Hartsock and Graves (1976) outlined 3 explanations for the lower incidence of mortality in earlier-born piglets (Figure 2). Earlier-born piglets are heavier than piglets born later in the litter (Harmon, et al., 1972; Hartsock and Graves, 1976; Hartsock et al., 1977). Unfortunately, the physiological cause for this difference is unknown. Since heavier piglets win more fights during establishment of the teat order, and they also tend to become the dominant individuals, it is likely that they nurse more frequently. In turn, this leads to a greater consumption of colostrum and milk which enhances survivability. Recent results show clearly that piglets dominant during lactation weigh more at birth and have faster gains to 3 weeks of age than subordinate pigs (Scheel et al., 1977). In

contrast, lighter piglets at birth are probably not as strong as their heavier littermates. These piglets are therefore more apt to be crushed by the sow or succumb to chilling.

Earlier-born piglets are stressed less during farrowing.

Washington State data also show that piglets dying before 21 days of age were born 83 min after the previous pig, whereas surviving piglets were born 35 min after the pig immediately preceding them (Table 1). The longer time spent in utero by these piglets probably subjected them to more uterine muscle contractions, which reduced placental blood flow. Umbilical blood flow to these piglets may also have been reduced or the umbilical cord may have ruptured. Perhaps the placenta became separated from the uterus as parturition advanced. Premature separation of the placenta from the uterus or umbilical cord rupture would tend to cause perinatal hypoxia (Figure 2). This is evidenced by the piglets gasping for air at birth. Perinatal hypoxia is associated with a decrease in blood serum pH, which in turn results in less viable piglets. Since these piglets might be more concerned about breathing than eating, they would be less vigorous at birth. This, in turn, would result in less fighting success and a reduced consumption of milk.

Colostrum absorption.

The last explanation for the reduced incidence of preweaning mortality in earlier-born piglets is that these piglets have more time to locate mammary glands and imbibe colostrum than later-born piglets (Figure 2). Piglets must acquire some colostrum to insure their survival. Colostrum has a higher protein content than milk, which is due mainly to a high immunoglobulin level. Immunoglobulins contain antibodies which protect the piglet from systemic infections until it can begin to synthesize antibodies around 10 to 20 days of age. Piglets

have only 1 mg of immunoglobulin per ml of blood serum before they nurse, whereas after 12 hr of nursing the serum levels rise to 40 mg per milliter. The large immunoglobulin molecules are absorbed from the small intestine into the blood by a process known as pinocytosis. Nursing piglets absorb immunoglobulins until they are 24 to 36 hours of age, and fasted piglets retain the ability to take up macromoloecules until at least 86 hours. Digesta appears to accelerate gut closure (Leary and Lecce, 1976). The open gut is beneficial to the piglet because it permits acquisition of passive humoral immunity for protection against systemic infections. However, the relatively permeable gut also permits direct access of environmental contaminants, such as dirt and microbes, into the vascular system (Lecce, 1975).

Bourne (1969a,b) reported that immunoglobulins in the udder of sows decreased by 50 percent after piglets nursed for a 4-hr period. Coalson and Lecce (1973) reported that piglets allowed to nurse after farrowing ended had only half the immunoglobulins of their littermates which suckled 4 hr earlier. Since parturition generally lasts 3 to 4 hours, piglets born later in the litter may not receive adequate immunoglobulin.

If this hypothesis is true, one remedy to save more of the later-born piglets would be to remove all piglets from the dam at birth. At completion of farrowing, all piglets could be returned simultaneously to the sow so they would have an equal opportunity to compete for colostrum. Since the gut remains open for several hours after birth in fasted piglets, they would still be able to acquire a high concentration of circulating immunoglobulins. In addition, removal of piglets at birth could reduce distractions to the dam during parturition, which could be particularly beneficial to the nervous gilt.

Results of studies at Washington State University showed that removal of piglets from the dam at birth did not alter the average serum immunoglobulin concentration of the litter when compared to litters that nursed immediately

after birth. Survival of piglets to 21 days of age was not affected. Piglets that had a higher gamma globulin concentration at 12 hr of age were heavier at birth, had greater weight gains to 21 days of age, had a greater chance of surviving to weaning and tended to be born earlier in the birth order. These results strengthen the suggestion that piglets surviving to 21 days of age are stronger at birth.

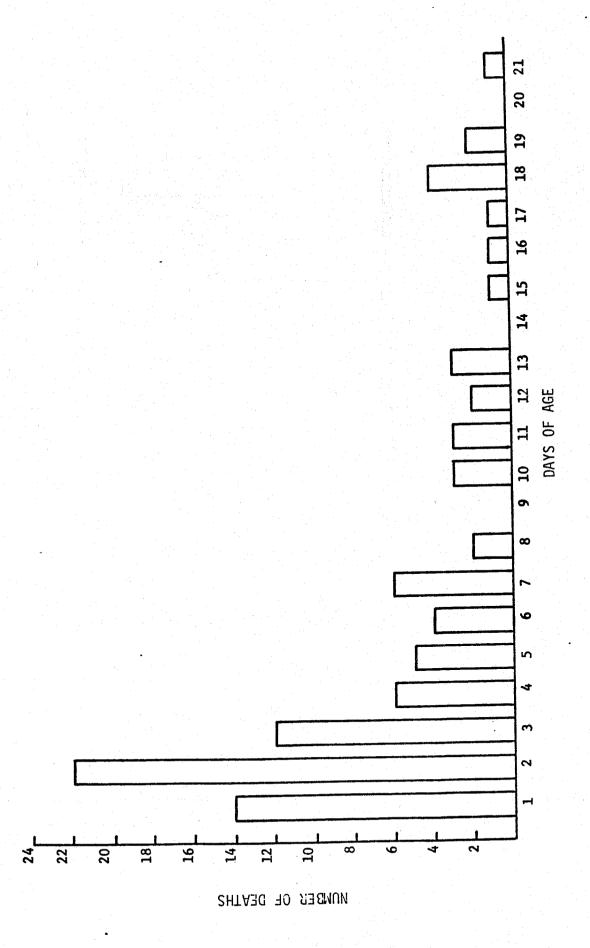
RECOMMENDATIONS

What can the pork producer do to reduce losses of piglets before weaning?

Concentrate on farrowing house facilities and management, particularly during the first 72 hr of the piglet's life. Have an attendant present at farrowing. Remember that the piglet is very susceptible to a cold environment during this time. The piglet is wet at birth. It is practically hairless and has little fat to insulate it from a cold environment. Farrowing houses should be insulated well. Solid partitions should be used between farrowing crates and a solid floor should be used in some part of each farrowing unit.

Keep piglets warm and dry. If possible, use straw bedding. Farrowing house temperature should be around 27C (80F), even when heat lamps or gas heaters are used. Be sure that this temperature is maintained at floor level, not at a thermostat that is 4 feet above the piglet's immediate environment. Drafts effectively reduce air temperatures.

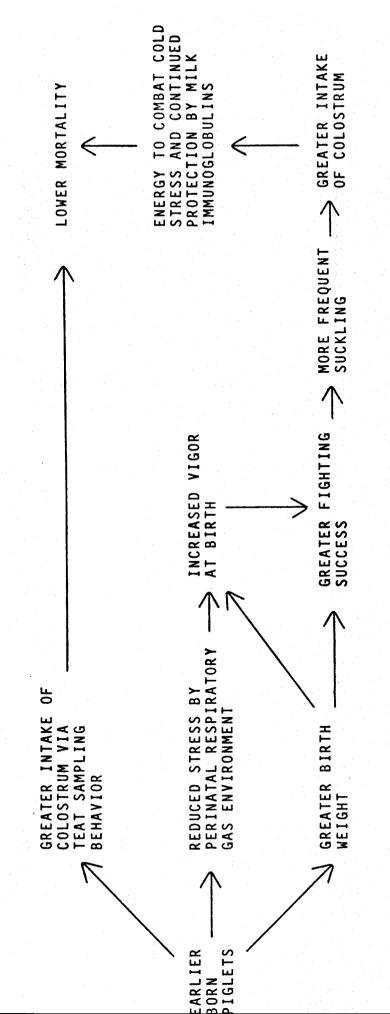
Remember also that the piglet provides the best assessment of the thermal environment. When piglets are sitting with all four legs beneath them or when their hair is bristled, they are responding to the cold environment. Whenever piglets are huddled together or buried 4 deep beneath a heat lamp, producers should concentrate on improving the piglets' thermal environment.



Hartsock et al., 1977.



POSSIBLE CAUSES OF THE REDUCED INCIDENCE OF PREWEANING MORTALITY IN EARLY-BORN PIGLETS. FIGURE 2.



Hartsock and Graves, 1976.

TABLE 1. CHARACTERISTICS OF PIGS DYING BEFORE 21 DAYS OF AGE. 1

| | | Pig1 surviving | lets not |
|--------|-------------------|----------------------------------|--|
| Number | Criteria | Number | Criteria |
| 476 | 1.31 | 115 | 1.10 |
| 473 | 39.8 | 95 | 27.8 |
| 413 | 34.6 | 146 | 82.7 |
| 476 | 6.0 | 158 | 7.1 |
| | 476 473 413 | 476 1.31 473 39.8 413 34.6 | to 21 days surviving Number Criteria 476 1.31 115 473 39.8 95 413 34.6 146 |

¹Hendrix et al., 1977.

SUMMARY

Pork producers are losing uncounted dollars every year due to baby pig losses. Nearly two pigs are lost before weaning in every litter. Substantial savings would accrue to pork producers by simply cutting these losses in half.

Piglets that die before weaning are smaller at birth, consume less colostrum, have a longer birth interval and are born later in the litter than piglets that survive. Many of the piglets die during the first few days of life. Producers should concentrate on improving husbandry practices in the farrowing house during the first few days of the piglet's life in order to reduce baby pig mortality.

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SOME RELATIONSHIPS AMONG INDIVIDUALS AND LITTERS CONCERNING BABY PIG SURVIVAL

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Data were analyzed on 634 piglets from 57 litters in the Oregon State University herd. Dams were both gilts and sows and included Berkshires, Yorkshires, and crosses of these breeds. The purpose of this study was to investigate those factors which appeared to be associated with baby pig survival (Bereskin et al., 1973; Fahmy and Bernard, 1971). Many factors have already been proposed; late born piglets (Hartsock et al., 1976), prenatal respiratory stress (Stanton and Carroll, 1974; Curtis, 1974), low birth weight (Fahmy and Bernard, 1971), lack of vigor (England, 1974), low social standing (Gill and Thomson, 1955), size of litter (Bereskin et al., 1973), nutritional stress (Sampson et al., 1942), immunoglobulin deficiency (Wilson, 1974) body heat loss (Curtis, 1970, 1974; Morrill, 1952), and genetic background (England, 1974).

Of equal importance was the attempt to identify and use a mortality measurement that accurately described occurring deaths. Hartsock and Graves (1976) measured percent mortality of newborn piglets grouped according to birth order. A definitive correlation between birth weight and deaths resulted. Stanton and Carroll (1974) used rectal temperature as an indicator of survival ability based on the assumption that the weaker pigs in a litter are less able to maintain a normal temperature under severe stress.

Using the first 35 days of the neonate's life as a base, the number of days of survival were measured in our study. This provided a death measurement which was not unduly influenced by data manipulation and provided a direct measure of survivability.

EXPERIMENTAL PROCEDURE

Data were collected on the 634 piglets in the following areas: litter, birth

order, birth weight, birth sequence time, total birth time, litter size, days of survival, birth month, breed of dam, parity of dam, and the number of gestation days. The first analytical procedure was to determine means and correlations of all variables and possible combinations of them on all of the piglets (group A).

Following this analysis, it was decided that a subset of the data should be examined. This subset consisted of only those which had died (95 piglets). Means with their respective standard deviations and correlations were calculated. Means of the variables in this subset (group B) were then compared to the overall group (A) and correlation differences between groups noted. Frequency of death by day of age was also measured in this group.

In a study of total litter data examined on 39 dams (groups C and D), Group C considered of 7 litters characterized by high mortality; Group D consisted of 32 litters of low mortality. Although some dams had farrowed twice during this study, only data from the first one were used to prevent possible bias. Comparisons were made using number of deaths per litter. Means, standard deviations, and correlations among the variables were then compared between Group C and Groups A, B, and D to establish any differences between the litters having high mortality and the others.

Following analysis of the litter data, individual piglets in Group C were compared. Comparison of means and correlations between those piglets which lived and those that died (Groups E and F) in the seven litters were completed along with comparsion of these to the overall (A) and subset (B) groups. Within litter differences between pigs that lived and those which died were also examined in the seven litters.

RESULTS AND DISCUSSION

Listed in table 1 under Group A are the mean descriptions of the variables observed on all piglets. The average number of pigs born per litter was 11 and the mean birth weight was 1182 g (2.6 lb). Using the aforementioned 35-day base,

COMPARISON OF MEANS OF THE VARIABLES BETWEEN DIFFERENT GROUPS OF PIGS

| Group | Birth weight (g) | Birth sequence time (min) | Total birth time (min) | Litter size | Days of survival |
|-----------------|-----------------------------------|------------------------------------|------------------------------|----------------------------|---------------------------------|
| A (634 piglets) | 1182 <u>+</u> 308 ^a | 13 <u>+</u> 24 ^a | 78 <u>+</u> 75 ^a | 11 <u>+</u> 3 ^a | 30 ± 5 ^a |
| B (95 piglets) | 932 <u>+</u> 331 ^a | 16 <u>+</u> 28 | 90 <u>+</u> 74 | 13 <u>+</u> 3 ^a | 4 <u>+</u> 6 ^a |
| C (7 litters) | 1055 <u>+</u> 195 ^b ,d | | 151 <u>+</u> 47 ^b | 14 <u>+</u> 2 ^b | 33.7 <u>+</u> 7 ^b ,e |
| D (32 litters) | 1227 <u>+</u> 384 ^b ,d | | 152 <u>+</u> 46 | 10 <u>+</u> 3 | 13.1 \pm 3 ^{b,e} |
| E (34 piglets) | 870 <u>+</u> 284 ^c | 15 <u>+</u> 24 ^{c,f} | 83 <u>+</u> 61 ^c | 14 <u>+</u> 2 ^c | 5 <u>+</u> 3 ^c |
| F (65 piglets) | 1147 <u>+</u> 241 ^c | 9 <u>+</u> 11 ^f | 75 <u>+</u> 55 | 14 <u>+</u> 2 | 34 <u>+</u> 0 ^c |

a,b,c Means sharing common superscript are (between groups) significantly different at P<.01).

d at P<.U1).
Total litter weights differed significantly at P<.10.
Percent litter mortality.
Significant difference noted at P<.10.

average survival time was 30 days with an overall mortality rate of 15%.

Shown in table 2 under Group A are the significant correlations for the 59 litters. There are indications that non-variable conditions exist. Total birth time and litter size, the latter which correlates well to birth order, have a relatively low association. This should indicate that total birth time is not dependent upon the size of the litter.

Table 1 compares the overall means and standard deviation of the means (Group A) with the similar statistics of the mortality subset (Group B). This subset differed from the overall group (unpaired t-tests) as follows: average birth weight was reduced 250 g (.6 lb), average litter size was increased by two pigs and predictability —the length of survival time—was decreased 26 days.

Simple correlations were also computed on this subset and are listed under Group B in table 2. The most noticeable change was a drop in the relationship between days of survival and birth weight. This suggested that within the category of low birth weight, size of the piglet at birth had little influence on the length of time until death occurred. Further examination of this subset in terms of the frequency of death revealed the following: 60% of the piglets died within the first three days and 90% died within the first nine days. Table 3 lists a percent frequency distribution illustrating death rate and days of age.

The differences in birth weight and litter size indicates an unequal distribution of these for groups A and B. It is our hypothesis that a certain amount of random death occurs as the result of management levels imposed by economic, physical, and knowledgeable limits. In essence, the causes of this death are extensively varied. Random death should, by its description, be distributed normally throughout the litters farrowed. The non-random distribution, centering around birth weight and litter size difference between groups, indicates important but unidentified factors as causes of a substantial proportion of mortality.

Based on the number of actual deaths per litter, it can be shown that

TABLE Z. CORRELATIONS AMONG CHARACTERISTICS OF DIFFERENT GROUPS OF PIGS

| | 1 | 0.241 | | | | | | | | | | | |
|-------------------|----------------------------------|-------|--|---|--|---|-----------------------------|------------------------------------|---|----------------------------|--------------------------------|------------------------------------|----------------------------------|
| Group | Birth order — D Total birth time | | Birth order Litt- ter size | Birth month Parity of dam | ter ter size z Breed of | Birth wt. Days of surv. | Parity of dam Days of sest. | Birth wt. Birth month | Birth wt. Lit- ter size | Breed of dam Days of gest. | Total birth time Lit- ter size | Birth order Birth wt. | Birth Month Days of |
| A (34 piglets) | • 63 | .41 | .38 | 38 | .35 | .35° | .35 | 34 | 27 | 20 | . 20 | 17 | .01 ^d |
| B (95 piglets) | .67 | .41 | •45 | 41 | .23 | .14 ^e | .45 | 15 | 25 | 20 | .18 | 15 | .21 ^f |
| C (7 litters) | . 68 | .39 | .32 | 58 | .14 | .26 | .58 | 14 | 29 | 32 | .01 | 43 | |
| D (32 litters) | .76 | .21 | | | | | | 51 ⁸ | .84 ^h | | | 60. | |
| | | | | | | | | | | | | | |

 a Only those variables having a relationship greater than \pm .20 in any of the groups are listed. $^{\mathrm{b}}$ Correlations expressed are for each vertical pair of characteristics.

^CPartial correlation = .38.

dPartial correlation = .15.

Partial correlation = .15.
f Partial correlation = .18.

 $\mathbf{g}_{ extsf{Total}}$ litter weight correlated with birth month of selected litters.

 $^{
m h}$ Total litter weight correlated with litter size of selected litters.

TABLE 3. DAILY AND CUMULATIVE PERCENTAGE OF TOTAL FATALITIES OF THE 95 PIGLETS WHICH DIED (GROUP B)

| | | Days of | Age | |
|-----------------------------|-------|---------|-------|-------|
| | 0 - 3 | 4 - 5 | 6 – 7 | 8 - 9 |
| Percent of total fatalities | 60.0 | 13.7 | 10.5 | 5.3 |
| Cumulative Percentage | 60.0 | 76.7 | 84.2 | 89.5 |

TABLE 4. LITTER ARRANGEMENT BY ACTUAL DEATH LOSS

| | · Piglets Lost Per Litter | | | | | | | | |
|---------------|---------------------------|-----|-----|-----|-----|-----|-----|-----|---|
| Litter Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 77 | 8 |
| (n = 39) | 927 | 934 | 954 | 941 | 905 | 964 | 931 | 944 | |
| | 924 | 960 | 910 | 985 | 959 | | | | |
| | 967 | 933 | 965 | 990 | 906 | | | | |
| | 902 | 958 | 937 | | 976 | | | | |
| | 963 | 922 | 955 | | | | | | |
| | 942 | 969 | 984 | | | | | | |
| | 981 | 938 | 915 | | | | | | |
| | 975 | 925 | 982 | | | | | | |
| | | 935 | 978 | | | | | | |
| | | 901 | 899 | | | | | | |
| | | 943 | | | | | | | |

approximately 75% of the litters averaged a 1.07 pig loss (mortality rate = 10.6%). This data arrangement is shown in table 4. Based on an average litter size of 10 and a mortality rate of 10.6% for 82% of the group, we can make the assumption that random death accounts for a loss of one pig per litter. Therefore, there also appears to be a non-random concentration of death in several of the litters listed in table 5 (Group C) along with the remaining 32 litters (Group D). Approximately 46% of all the deaths occurred in this selected group of seven litters.

Comparison of the means of groups C and D (table 1) results in findings similar to that between the subset (B) and overall (A) groups. A significant difference exists between birth weight, litter size, and survival time for group C vs D. An additional conclusion to be drawn is that there is a similarity among these data in terms of a specific litter influence.

Comparison of the selected group (C) was further analyzed by dividing the individuals into two groups; those that died (Group E) and those that lived (Group F). As shown in table 1, mean litter size of both groups is similar to that of the total selected group (C), but birth weight and survival time were different between groups E and F.

Of all the variables measured, only those that showed evidence of being different among any of the groups were included in table 1. The mean for birth order was approximately 7 ± 5 for all groups except F, which had a mean of 8 ± 4 . Similarly, the mean for days of gestation was 114 ± 4 except for groups A and E which were 113 ± 3 and 115 ± 4 , respectively. The means and standard deviations for all groups were similar for the following variables: birth month, 8 ± 3 ; breed of dam (1-3), 3 ± 1 ; parity of dam, 3 ± 1 .

Not listed was a further compaison of the selected group involving two groups of individuals within each litter, based on whether they lived or died. This was done to determine any large discrepancies within litters, which in themselves vary. Although some differences were found in birth weight between groups in some litters,

TABLE 5. COMPARISON OF DEATH LOSS BETWEEN THE SELECTED GROUP (C) AND REMAINING LITTERS (D)

| | Piglets | Litters | Piglets which lived | Piglets which died | % Death loss | % Total litters | % Total deaths |
|---------|---------|---------|---------------------------|--------------------------|--------------------|-----------------------|----------------------|
| Group C | 99 | 7 | 65 | 34 | 34 | 18 | 46 |
| Group D | 322 | 32 | 282 | 40 | 12 | 82 | 54 |
| Totals | 421 | 39 | 347 | 74 | 18 | | |

no inference could be drawn due to the limited number of high mortality litters

In conclusion, we feel that the data reveal a common basis for the random death factor—specifically, certain litters. Further investigation of character—istics of underweight individuals and their interaction with environmental factors in these infrequent occurring litters, which are characterized by large litter size and high mortality rates, should result in means to achieve a significant reduction of overall death rate.

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DEVELOPMENT OF NEW FEEDSTUFFS FOR SWINE

P. R. Cheeke

An intriguing and promising area of swine nutrition research is the development and evaluation of new feedstuffs. The last few years have seen considerable public concern regarding the feeding to livestock of feeds that could be directly consumed by humans. Regardless of our feelings as livestock producers, it cannot be denied that feeding grain and soybean meal to pigs is a less efficient use of these resources than their direct consumption by humans. In the years ahead, the long-term trends will be for increased competition between man and his domestic animals for sources of nutrients.

In this regard, it is of interest that in many countries where population pressures are severe, the pig has an important role. the national goals of the Chinese is to develop a swine herd of 800 million, or about one pig per person. Assuredly, they do not plan to feed these animals a corn-soy diet. On the contrary, Chinese swine production involves the use of these animals as "garbage disposals," to convert waste products of food processing and other agricultural activities into pork. Such feeds as banana stems, water weeds, rice bran, table scraps, molasses, and by-products of rice distilleries and noodle factories are used. Animal and human wastes, recycled via fish ponds, are also used. The fact that the pig has a valuable role in the agricultural economy of a densely populated country like China gives us optimism that it will have an equally important role in our society. This optimism is not shared by all animal scientists; Dr. J. T. Reid of Cornell has stated "The pig is in the most precarious position of all farm animals in the United States from the standpoint of efficiency ... a pig enterprise

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requires a high subsidy of fossil energy, and it requires either feeds that humans can also consume directly or land for feed production that can also produce human food."

The above discussion suggests that on a long-term basis we need to give thought to the development of new feed sources for swine. What types of materials will be needed? For what types of feeds are humans and swine in greatest competition? The answer is clear, from a consideration of the nutrient requirements of the pig and the nature of typical hog rations. Only about 16% or less of the typical ration is crude protein. About 2% is mineral and vitamin supplements. The remainder or about 80% of the diet, consists of energy (calorie) providing materials, mostly carbohydrate. Thus, in contrast to what perhaps is common opinion, the greatest need for feed ingredients is not for protein, but for energy. Since humans also require much more energy than protein, we will be competing with livestock primarily for energy, rather than protein sources.

Currently used energy sources for swine in this country are primarily the cereal grains. Improvements in the efficiency of grain utilization are likely to be quite minor, since digestion of grains is quite efficient. In the future, we may see more grain processing by-products, rather than the grains themselves, used in swine feeding. In Oregon, the development of a large potato industry is leading to the production of large amounts of by product that could be used in swine feeding. Improvements in utilization of by-products, etc., can be expected to be a productive area of research.

It is my opinion that on a long-term basis, the development of new sources of calories for swine will be one of our biggest challenges; there are few obvious energy sources that would be suitable for swine but

not for direct consumption by humans. One possibility may be the increased use of fat, since there are good reasons to limit fat intake in the human diet.

Development of new protein sources appears to show more promise.

This is significant even though the quantity of protein supplement required is much less than of sources of energy. Several potential protein sources are receiving considerable research investigation at this time.

These include leaf protein concentrates, single cell proteins (algae, yeast, bacteria), and new crops like faba beans and sweet lupins.

Recycling of animal wastes is also a possibility. Limitations in waste recycling should be recognized. Since swine manure consists primarily of materials that couldn't be digested, it is not realistic to think that they would be well utilized when recycling. Culture of microorganisms such as bacteria, yeast or algae on wastes might be a more feasible procedure. Studies to date have shown that while this procedure is technically feasible, the economics do not justify commercial application at this point.

At Oregon State we have studied quite extensively the nutritive value of a protein concentrate prepared from alfalfa. This product is the equal of soybean meal as a protein supplement for swine. Again, its commercial application will be dictated by economics. Presumably the economic situation with this process is such that commercial application in the U.S. is not yet feasible.

Considering our local situation, there are a number of feed ingredients that deserve attention. Vegetable processing by-products are available. Grain and grass seed screenings might have some application in gestation diets. Such products as liquid whey are generally uneconomical

because of their high moisture content. Potato by-products may well assume more importance in the Hermiston-Boardman area.

In summary, this paper has discussed some implications for swine production resulting from greater direct use of grains and protein supplements as components of the human diet. As greater competition between humans and domestic animals occurs, swine producers will be forced to consider the use of "non-competitive" feedstuffs. The time frame for this is a matter of conjecture; in my opinion, it is not likely to occur for many years. Nevertheless, research on new feedstuffs is needed so that we can be prepared to meet this challenge.

MATING OF SOWS DURING LACTATION

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Sows generally mate and conceive a new litter a few days after weaning their litters at 21 to 56 days of age. Some sows with a small number of pigs come in heat prior to weaning. In the United States at present, mating sows during lactation is not generally practiced. A New Zealand study (Smith 1960) of the most efficient use of feed energy in swine production found that separation of sows from their litters during the daytime resulted in estrus during lactation; matings were fertile and there was no adverse effect on litter size or productivity. Second-litter sows used in the experiments exhibited estrus within a week of the start of separation, while the first-litter animals took approximately one week longer. A more recent study (Smith 1975) reported successful mating and litter productivity resulting from grouping lactating sows and their litters after 21 days post partum, and including a boar in the group for constant boar exposure.

The concept and practice of early weaning focuses on reproductive efficiency of the female. Self and Grummer (1958) showed that estrus occurred at an average of 9.4, 6.25, and 4.0 days after weaning when litters were weaned at 10, 21, and 56 days after farrowing. The number of ova increased from 12.8 for sows weaned on the tenth post partum day to 15.2, and 16.6 at 21 and 56 postpartum, respectively.

If mating of sows during lactation can regularly be achieved without decreased litter productivity, it will permit an alternate system to early weaning for increasing number of pigs produced per sow per period of time. Early weaning permits shorter interval between parturition than conventional length of lactation and thus more offspring/dam/year but it also imposes additional production requirements in facilities, nutritional programs, and care and management of early-weaned pigs.

OBJECTIVE

An experimental study of mating sows during lactation was initiated at Oregon State University in September 1976. The objective of this experiment was to assess the reproductive performance of sows mated during lactation in terms of number of days to mating, percent conception, number and weight of pigs born, and number and weight of pigs weaned. A further objective was to determine the effect of separation of the sow from the litter on growth of the pigs to weaning and during the first three weeks after weaning.

PROCEDURE

The experiment involved separation of the sows from their litters commencing at 18 to 24 days after farrowing. Equal numbers of dams were allocated to the control and treatment groups. Sows of similar parity were used in the control and treatment groups, and in most cases, sows of each pair of treated and control females were mated to the same boar to decrease possible boar effect on reproductive performance between control and treated groups.

Sows and their litters were housed individually in farrowing crates and then in 8'x10' pens from farrowing to weaning of litters at 42 days of age. Sows used as the treatment group were removed from their pens for 6 hours daily beginning at 18-24 days after farrowing. For the first 2 days, these sows were grouped in a pen by themselves during separation. Beginning on the third day, a boar was in the pen with the group for the 6 hours they were separated from their litters. Sows were observed for mating performance and day of mating was recorded. Information was recorded on litter weight on day of initial separation, at weaning, and weekly for the first 3 weeks after weaning. Information on the same performance traits was collected for sow and litter performance of the control group, but the control sows were not separated from their litters until weaning at 42 days.

RESULTS

The absence of the dams from litters for 6 hours per day had no significant adverse effect on litter performance at weaning for those litters nursing the sows at that time (table 1). The average weaning weight of the control and treatment litters was 17.8 and 17.6 lbs, respectively (N.S.) and the percentages of death, or removal of pigs between 21 and 42 days of age due to poor milk production of the sows, was similar in control and treated groups. The difference in average number of pigs per litter was due to unequal size of litters before the sows were allocated, without regard to litter size, to the control and treatment groups. It should be emphasized that data in tables 1 and 2 are from the litters nursing the sows serving as controls and treated during the time of separation of the treated sows from their litters.

The influence of absence of dams on suckling and post-weaning gain of pigs is shown in table 2. From initiation to weaning, average daily gain was similar (.34 vs .38 lbs) for the treatment and control sows' litters. From weaning to the third week post-weaning average daily gain of the treatment sows' litters significantly exceeded that of the control for two of the three weeks and for the total period.

In the control group, 54% of the sows expressed estrus and mated within 1-5 days whereas only 31% did so in the treatment group. During the next five days, 50% of the treatment group mated whereas none of the control group did (table 3). The percent which mated within 20 days from initial exposure was 86 and 96 for the control and treated groups, respectively. Average number of days to mating (within 20 days) was 7.7 and 7.0 for control and treatment sows, respectively. In the control and treatment groups, 67 and 69%, respectively, farrowed from mating within the first 20 days following exposure (table 3); 14 and 0% failed to come in heat in the control and treatment groups, respectively.

TABLE 1. INFLUENCE OF TEMPORARY ABSENCE OF DAMS ON SURVIVAL AND WEANING WEIGHTS
OF CURRENT LITTERS (28 and 26 litters for control and treatment groups)

| | Control | Treatment | Differences |
|---|---------|-----------|-------------|
| Average number alive at 21 days | 9.0 | 8.3 | 7 |
| Average number nursing dam at 42 days 1 | 8.3 | 7.5 | .8 |
| Percentage remaining with dam from 21-42 days | 92% | 90% | 2% |
| Average weaning weight/pig (1bs) | 17.8 | 17.6 | .2 N.S. |

Several pigs were removed from some sows because of poor milk production.

TABLE 2. POST-WEANING GAINS OF PIGS FROM WHICH DAMS HAD OR HAD NOT BEEN REMOVED FOR SIX HOURS DAILY FOR SEVEN OR MORE DAYS DURING LACTATION¹

| Average Daily Gain (1bs) | Control | Treatment | Difference |
|--------------------------|---------|-----------|------------|
| Initiation to weaning | .38 | .34 | .04 N.S. |
| 1-7 days post-weaning | .39 | .53 | .14** |
| 8-14 days post-weaning | .56 | .63 | .07 N.S. |
| 15-21 days post-weaning | .62 | 1.03 | .41** |
| 1-21 days post-weaning | .52 | .73 | .21** |
| | | | |

N.S. - No significant difference

^{**}Significant difference (P<.01)

¹28 and 26 litters for control and treatment groups, respectively.

TABLE 3. BREEDING PERFORMANCE OF SOWS MATED AFTER WEANING OR DURING LACTATION

| | Control | Treatment | |
|---|----------|-----------|--|
| Total number exposed for mating | 28 | 26 | |
| Total number mated | 24 | 26 | |
| Percentage mating during 1-5 days of exposure | 54% | 31% | |
| Percentage mating during 6-10 days of exposure | 0% | 50% | |
| Percentage mating during 11-15 days of exposure | 7% | 11% | |
| Percentage mating during 16-20 days of exposure | 18% | 4% | |
| Percentage mating after 20 days of exposure | 7% | 4% | |
| Percentage that did not mate | 14% | 0% | |
| Percentage mating from 1-20 days | 86% | 96% | |
| Average number of days to mating (within 1-10 days) | 4.0 | 5.2 | |
| Average number of days to mating (within 1-20 days) | 7.7 | 7.0 | |
| Total sows farrowed from mating at first estrus | 16 (67%) | 18 (69%) | |
| Sows that rebred | 1 (4%) | 3 (12%) | |
| Late breeders | 2 (7%) | 1 (4%) | |
| Did not breed | 4 (14%) | 0 | |
| Bred but did not farrow 1 | 5 (21%) | 4 (15%) | |

¹ Includes sows removed for various reasons not directly related to the experiment.

Litters resulting from mating sows during lactation did not differ significantly from those farrowed by sows mated following weaning of their litters at 42 days of age except for average weight at weaning; litters from the sows mated during their previous lactations were significantly heavier at weaning (table 4). There are no obvious reasons for a favorable effect of mating during lactation on milk production during the subsequent lactation. It is assumed, therefore, that although significant, this difference is due to random chance and that it is not a reflection of a physiological effect of the treatment.

DISCUSSION

Thus far, the results of this experiment indicate that sows will express estrus and successfully mate during lactation. There seems to be no depression of birth weight, number born, litter size at weaning, or pig weaning weight performance. Reproductive and litter performance of control and treated groups in this experiment are below that usually achieved in the herd. Specific causes are not apparent; in general, poor milk production has been apparent, and includes considerable variation by different udder sections of the same sow.

Sows exposed for mating during lactation in the current experiment farrowed at an approximately three weeks shorter interval than sows mated following weaning of their litters. For a herd producing litters twice yearly from mating following weaning at 42 days of age of litters, this would decrease total non-lactating gestation time by 18%. In a herd producing 100 litters from each of two farrowings by each dam, the time saved equals approximately 4200 days; 4200 days equals the total gestation time of approximately 37 litters. At 8 pigs weaned/litter, 296 additional pigs could be produced in the non-lactating gestation time saved by mating during lactation. Stated differently, it could be said that the same number of pigs could be produced with 18% fewer sows through shortening the farrowing by three weeks as a consequence of mating during lactation.

TABLE 4. LITTER DATA FOR DAMS FARROWING AS A RESULT OF MATING AFTER WEANING OR DURING LACTATION

| | After weaning | During lactation | Difference |
|-----------------------------|------------------|---------------------|------------|
| Number of litters | 19 | 22 | |
| Average number born alive | 10.8 | 10.3 | .5 N.S. |
| Average birth weight (lbs.) | 2.8 | 3.1 | .3 N.S. |
| Average number weaned | 7.6 | 7.9 | .3 N.S. |
| Survival percentage | 70% | 77% | |
| Average weaning weight/pig | 18.1 | 21.2 | 3.1** |

^{**} Significant at P=<.01

An additional management advantage of mating during lactation is that individual sows with high milk production could continue to be used, after their litters were weaned, as foster mothers for "tail ender" pigs without delay of the next farrowing.

CONCLUSION

The mating of sows during lactation should continue to be researched. It seems to be an alternative to early weaning plus an advantageous system in terms of the sows' reproductive efficiency and litter productivity before and after weaning. The system shows potential for increased efficiency in the swine industry through (a) saving of feed by breeding three weeks earlier while the dam is still nursing her litter; (b) increasing number of pigs produced/sow/year; and (c) a more flexible use of the sow for rearing foster pigs. The experiment is continuing in order to obtain results with larger numbers, and to examine some additional aspects.

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PRODUCTION EFFECTS OF AN INHERITED SPINAL DEFORMITY

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In the spring of 1975 a spinal deformity was observed in a small proportion of the Oregon State University swine herd. The expression of the deformity varies from barely visible to severe enough to occasionally interfere with normal movement at heavier weights. This deformity has intentionally been allowed to remain in the herd so that we may be able to more closely study its cause and origin. In affected pigs, the spine curves downward at about the fifth vertebra then resumes a normal pattern. This spinal structure results in a dip just behind the shoulders instead of a normal straight or clean arching back.

Preliminary research indicates that the deformity as it occurs in the Oregon State University herd is genetic in nature; it can be traced nearly completely to one boar line. In most cases the deformity is expressed when both parents are at least one third related to this line; however, isolated cases have been found in which a carrying parent mated to a non-carrying parent has produced mildly deformed offspring. Other herds are reported to have experienced a similar deformity as a result of induced nutritional deficiencies (Miller et al., 1964; Kohler, 1966). At Oregon State University, further research is being done to determine more precisely the pattern of genetic transmission involved, and the possible role of nutritional deficiencies in its occurrence.

This report describes work done to determine what effect the deformity has on production traits of market hogs.

EXPERIMENTAL PROCEDURE

Pigs were randomly selected at approximately 60 pounds and grouped according to the degree of spinal deformity (dip) as assessed visually; 0 was used to designate normal or control pigs, 1 to designate mild deformity, and 2 to designate a

large deformity. Three replications of 8 pigs each for each classification of deformity were used. Pigs were weighed bi-weekly and feed consumed was recorded to determine average daily gain (ADG) and feed efficiency (FE). During the test period, three pigs died and three others were removed from the test. Twenty-two pigs in each group completed the experiment. Each was taken off feed test when average weight was about 205 lbs.

At approximately 225 lbs weight, pigs were shrunk for 24 hours and were sent to the Oregon State University Clark Meat Science Laboratory for slaughter. The following carcass data were taken: (1) slaughter weight (prior to shrink); (2) chilled carcass weight; (3) dressing percent; (4) carcass length; (5) average backfat thickness; (6) loin eye area; (7) loin weight; (8) ham weight; (9) picnic weight; (10) butt weight; (11) color score, 1 - light--5 - dark (National Pork Producers Council); and (12) marbling score, 1 - slight--5 - abundant (National Pork Producers Council). Group means were calculated for each trait and compared for significance of differences by use of Tukey's ω procedure (Steele and Torrie, 1960).

RESULTS AND DISCUSSION

The degree of deformity had no significant effect on either average daily gain or feed efficiency (table 1). Table 2 contains averages for the carcass traits. All significant differences were slight except backfat thickness and there was no overall trend of differences. Pigs of classification 2 were slaughtered at a slightly, but significantly, heavier weight than the other two groups but their dressing percent was lower and consequently chilled carcass weights were more nearly the same for the groups. Pigs of classification 2 had significantly longer carcasses; however, when adjusted for slaughter weight, there was no significant difference. This group also had significantly lower average backfat thickness which indicates a real difference in this trait.

TABLE 1. AVERAGE DAILY GAIN AND FEED EFFICIENCY OF MARKET HOGS WITH VARYING EXTENT OF A SPINAL DEFORMITY

| | Extent of deformity | | |
|-------------------------------|---------------------|-------------------|-------------------|
| | 0 | 1 | 2 |
| Number on test | 22 | 22 | 22 |
| Average weight on test (1bs) | 63.0 | 63.7 | 65.3 |
| Average weight off test (1bs) | 208.0 | 205.3 | 205.3 |
| Average daily gain (lbs) | 1.76 ^a | 1.67 ^a | 1.74 ^a |
| Feed efficiency (lbs) | 3.27 ^a | 3.10 ^a | 3.22 ^a |

^{10, 1, 2} indicate none, mild, and pronounced deformity, respectively.

TABLE 2. AVERAGES OF CARCASS TRAITS OF MARKET HOGS WITH VARYING DEGREES OF SPINAL DEFORMITY

| | Extent of deformity | | |
|------------------------------|---------------------|--------------------|--------------------|
| Trait | 0 | 1 | 2 |
| Weight at slaughter (1bs) | 224.1 ^a | 224.1 ^a | 228.7 ^b |
| Chilled carcass weight (1bs) | 160.3ª | 163.1 ^a | 161.9 ^a |
| Dressing percent | 71.5 ^a | 72.8 ^b | 70.8 ^a |
| Carcass length (in) | 31.3 ^a | 31.4 ^a | 31.8 ^b |
| Average backfat (in) | 1.31 ^a | 1.35 ^a | 1.23 ^b |
| Loin eye area (sq. in) | 4.19 ^a | 4.34 ^a | 4.35 ^a |
| Loin weight (1bs) | 28.4 ^a | 28.8 ^a | 28.6 ^a |
| Ham weight (1bs) | 32.8 ^a | 33.1 ^a | 33.3 ^a |
| Picnic weight (lbs) | 16.2 ^a | 16.2 ^a | 16.3 ^a |
| Butt weight (1bs) | 12.6 ^a | 12.8 ^a | 12.7 ^a |
| Color score | 2.8 ^a | 2.9 ^a | 2.8 ^a |
| Marbling score | 2.1 ^a | 2.4 ^b | 2.3 ^{ab} |

^{10, 1, 2} indicate none, mild, and pronounced deformity, respectively.

 $^{^{\}rm a}$ Comparisons among values within horizontal columns; those values having the same superscript are not significantly different at P<.05.

a,b Where superscripts are different within horizontal rows, averages are significantly different (P<.05).

There were no significant differences in average weights of any of the four lean cuts, nor in loin eye area or color score. There did seem to be a trend in marbling score; although slight, both groups of hogs with deformities had more marbling than did the normal hogs.

SUMMARY

An experiment was set up to determine any production differences in hogs with various degrees of spinal deformity. Three groups were tested, a normal or control group (0), a group with a mild deformity (1), and a group of more severely deformed hogs (2). No significant differences were found for average daily gain or feed efficiency; there were significant but slight differences in some carcass traits. Death loss and number of unthrifty pigs appeared random in this test. Average backfat thickness and dressing percent were lower for the group with most deformity. In general, within the limits of the experiment, the deformity had no adverse effects of practical importance on growth rate, feed efficiency, or any carcass trait.

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