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Abstract

Management and biological factors combine to limit litter size in swine herds. With present technology, improving litter size depends upon increasing the number born in the first litter and prolonging sow longevity. Methods for improving size of the first litter rely on increasing the number of eggs ovulated and include flushing (increased feed for at least 10 days before breeding), selecting breeds with high ovulation rates, and delaying breeding until after the pubertal or first estrus. The first two methods are the most cost effective under farm conditions. Because litter size peaks at the fourth or fifth litter, it is also important to increase the proportion of multiparous sows in the herd. This can be accomplished by not culling sows as long as they are productive.; Swine Day, Manhattan, KS, November 19, 1987

Keywords

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INCREASING LITTER SIZE IN SWINE HERDS

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Summary

Management and biological factors combine to limit litter size in swine herds. With present technology, improving litter size depends upon increasing the number born in the first litter and prolonging sow longevity. Methods for improving size of the first litter rely on increasing the number of eggs ovulated and include flushing (increased feed for at least 10 days before breeding), selecting breeds with high ovulation rates, and delaying breeding until after the pubertal or first estrus. The first two methods are the most cost effective under farm conditions. Because litter size peaks at the fourth or fifth litter, it is also important to increase the proportion of multiparous sows in the herd. This can be accomplished by not culling sows as long as they are productive.

Introduction

Litter size at weaning is accepted widely as a primary limiter of the efficiency of pork production. Replacement gilts constitute between 25 and 50% of the breeding herd on most swine farms and gilts generally farrow and wean smaller litters than older sows. In addition, numbers of pigs farrowed in the second litter are often less than in subsequent litters. Therefore, management goals to improve litter size are to: 1) increase the proportion of older (3rd or later parity) sows in the herd and 2) increase litter size in young females. Procedures for achieving these goals and results under experimental conditions are considered in this report.

Procedures to Improve Litter Size

In order to improve a complex biological trait like litter size, it is first necessary to determine the components of the trait and the factors that affect each component. There are four components of litter size that can be easily identified, these are: 1) number of eggs ovulated (ovulation rate); 2) percentage of eggs fertilized (fertilization rate); 3) percentage of embryos surviving early pregnancy (until about day 30); and 4) percentage of fetuses surviving to farrowing.

Notice that ovulation rate effectively sets the upper limits for litter size. In practice, this is particularly true for replacement gilts, and it can be deduced from available evidence that ovulation rate in young gilts is often not adequate to challenge the capacity of the uterus to carry fetuses to term. In addition, the second litter is usually smaller than subsequent litters and may not be larger than the first litter. The practice of summarizing reproductive records without sorting into parity groups does much to hide the effect of replacement gilts on pig production.

Because of this "carry-over" effect of parity into the second litter, the effects of replacement gilts on litter traits represent a "double whammy." First and second litters combined often account for 40 to 50% of the farrowings. Therefore, strategies to improve litter size should be targeted on those females. Rates of ovulation, fertilization, and embryo and fetal survival must each be addressed, if litter traits are to be improved. One might also attempt to shift the age distribution for the herd, so that older females constitute a larger percentage of the breeding females.

The Distribution of Parity

Altering the distribution of parity within a sow herd is accomplished by retaining sows for more litters. Increasing the proportion of older sows may be difficult to accomplish in many herds where culling decisions based on injuries, health (involuntary culling), and previous reproductive performance (voluntary culling) predominate. For example, Pattison and his colleagues found that among 60 herds in Great Britain, 50% of the cullings before the third litter were the result of fertility problems and only 55 percent of sows remained in the herd long enough to produce a fifth litter. The overall summary of the reasons for culling in the British herds is presented in table 1. Preliminary studies of the parity distribution in two Kansas herds reveals that only 25 and 31 percent of sows farrowed five or more litters. Therefore, early culling of sows may be more common in Kansas than in Great Britain.

Management factors that minimize sow injuries and nutritional programs that maintain adequate body tissue reserves can be expected to retain more older females in the breeding herd. Managers can do much to reach desirable parity distributions within their herds by being aware of the effects of parity on litter traits and using this information to formulate realistic strategies and goals for their herds.

Most data summaries indicate that litter size reaches a maximum by the fourth or fifth litter. Figure 1 presents the situation in one Kansas herd. To manipulate the age distribution of a herd it is necessary that a sow not be culled until it can be reasonably expected that a replacement gilt would farrow and wean at least as many pigs as the older sow. Therefore, sows should be retained as long as they are healthy and remain productive. Even so, it is unlikely that the proportion of replacement gilts can be held below 20 % of the herd. Therefore, for most herds, replacement gilts should be the first group targeted to increase litter size.

Increasing Litter Size at the First Farrowing

Because ovulation rate sets an upper limit on litter size, strategies for increasing ovulation rate are of central importance in gilt reproduction. There are three methods available to increase ovulation rate: 1) select breeds known for high ovulation rates; 2) provide more feed for at least the last 10 days before breeding (flush); and 3) delay breeding until the second or later estrus. We have been particularly interested in methods 2 and 3. Table 2 presents the summary of two experiments designed to test the effects of flushing on litter size at farrowing. It can be deduced clearly from these data that flushing was effective for increasing litter size only among gilts bred at puberty. This is likely because the unstimulated ovulation rates of these gilts were not adequate to challenge the capacity of their uteri. Gilts of similar age were assigned to the study, so the pubertal and postpubertal groups did not differ in chronological age. The improvement in litter size for gilts flushed with extra feed and bred at puberty was about 2 pigs born alive. This makes their litter size equivalent to that of gilts bred at a postpubertal estrus.

Maintaining Extra Embryos to Farrowing

This topic can best be addressed by considering the biological components of litter size and the methods for their improvement (table 3). Increasing the number of eggs released at ovulation by two is readily accomplished by flushing. Fertilization rate is typically high in pigs, but could be increased in many herds by hand mating and improving estrous detection. Embryo and fetal survival also might be improved by paying attention to such things as environmental temperature and herd immunizations. It is also true that most flushing treatments on swine farms continue the high feeding level into postbreeding and fail to consider the negative effects on embryo survival. Therefore, it is imperative when flushing to withhold the extra feed as soon as the gilt is detected in estrus.

The cumulative improvements in litter size throughout pregnancy achieved by the responses in table 3 are depicted in figure 2. In practice, it is difficult to maintain the advantage gained at one stage into the next stage. For example, increased ovulation rate also may be accompanied by higher losses of embryos, unless feed intake is decreased at mating.

Increasing Litter Size at the Second Farrowing

It was recognized recently that reduced litter size is often continued into the second litter. For example, our own data indicated that multiparous sows ovulate about three more eggs than primiparous sows. Multiparous sows also had a higher fertilization rate (93%) than primiparous sows (78%). The combined effect of lower ovulation and fertilization rates means that primiparous sows in our study began pregnancy with less than 14 embryos, a number comparable to their first pregnancy as replacement gilts. Other data suggest lower embryo survival for primiparous sows. Therefore, it is no surprise that litter size often either fails to increase or declines from the first to the second litter.

The precarious situation of primparous sows is illustrated by the work of R. J. Love in Australia (Vet. Rec. 104:238, 1979). Delaying mating of primiparous sows until at least 12 days after weaning improved litter size at farrowing. This improvement appears to have resulted from either improvements in fertilization rates or embryo survival. Ovulation rate was not affected by delaying mating until the second estrus, but the number of embryos on days 28 to 35 was about 10.4 for primiparous sows mated at second estrus compared with 9 for sows mated at first estrus. It is debatable if delaying mating is a cost-effective strategy for a swine herd. However, the research illustrates a critical recovery period for sows after weaning their first litter.

Conclusions

A combined strategy for increasing litter size in replacement gilts and increasing the longevity of sows is likely to yield the greatest return in litter traits. Procedures are available to boost litter size at the first farrowing; however, no practical methods for improving the number born in the second litter have been described.

Table 1. Some Reasons for Culling Breeding Females in British Herds[a]

Reason for culling	% of culled females
Age	24
Fertility Problems	31
Lameness	12
Poor Performance	14

[a]Adapted from Pattison, D., G. L. Cook and S. Mackenzie. Proceedings of the 74th Meeting of the British Society of Animal Production, pp. 462-463.

Table 2. Effects of Flushing on Litter Size in Gilts-Summary of Two Experiments[a]

	Pubertal		Postpubertal	
Item	No Flush	Flush	No Flush	Flush
No. of gilts	62	44	73	67
Litter traits				
No. born	7.9	10.5	10.1	9.9
No. born alive	7.3	9.6	9.3	8.9

[a]Weighted average from two Kansas State University experiments reported in the 1985 and 1987 Swine Day Reports of Progress.

Table 3. The Biological Components of Litter Size in Gilts and Practical Methods for Their Improvement

Item	Response possible: Biological response	Response possible: Increase in pigs born alive	Practical method for improving
Ovulation rate	+ 1.5 eggs	+ 1.0	Flushing; Breed selection; Breed after first (pubertal) estrus
Fertilization rate	+ .5 eggs	+ .3	Boar management; Hand mating
Embryo survival	+ .5 embryo	+ .5	Feeding level; Temperature; herd health
To be gained during pregnancy		1.8	

Dr. Duane Davis looks on while Kris Richardson, agricultural technician, weighs out a sample.

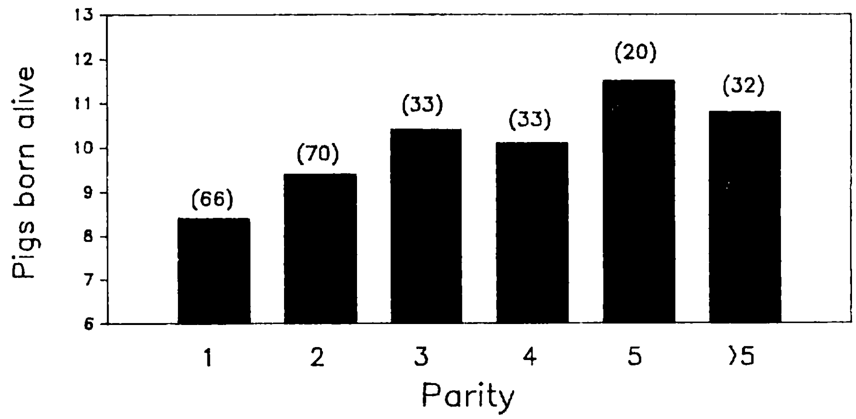

Figure 1. Effect of parity on number of pigs born alive on a Kansas farm (no. of litters).

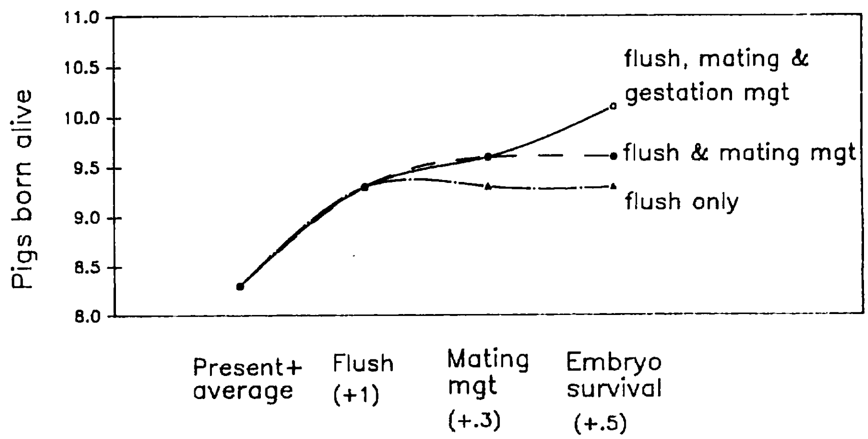

Figure 2. Potential improvements in the number of pigs born alive for gilts.