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OBTAINING OPTIMAL REPRODUCTIVE EFFICIENCY

To maintain optimal reproduction and throughput in a swine operation, a complete understanding of the operation and its productivity is required. Table 1 provides some key productivity indicators to use in maximizing throughput, along with suggested target values. Choosing which indicators to focus on depends on the individual operation. Most farms should verify that they have targeted an optimal weaning age, work toward increasing the average parity of the sow herd, and achieve two matings per service. Herds that have a low PSY (weaned pigs per sow per year) should focus on improving breeding techniques that enhance farrowing rate and reduce nonproductive days. Farms that are average in PSY should look at methods of improving litter size in addition to breeding techniques. Farms that are already doing an excellent job with PSY can look more closely at reducing pre-weaning mortality and improving litter weights to further maximize throughput.

The need for farms to focus on differing areas based on productivity is illustrated in Table 2. Good breeding techniques and low nonproductive days make it possible to achieve 2.5 litters per sow per year. When comparing the three sections of Table 2, it becomes apparent litters per sow per year and the traits and management techniques that determine this value are the most important factor in maximizing PSY. Obviously, improvements in the number of live-born pigs will also increase PSY, but even with 12 live piglets, if litters per sow per year is 2.1 or less, 25 PSY cannot be achieved. This table also demonstrates how reducing pre-weaning mortality can improve throughput but it shows, on the other hand, that large reductions in mortality often come at a fairly high cost.

The remainder of this article will describe in greater detail these indicators and their impacts on optimal reproduction.

Litters per mated female per year

To maximize the annual pounds of weaned pigs per mated female, an optimal number of litters per female must be achieved. The PigChamp datashare program reports that the top 10 percent of participating farms achieve 2.5 litters per mated female per year while the lower 10 percent reach only 2.08. This results in a 20 percent reduction in throughput, assuming equivalent performance in other parameters.

Nonproductive days: The most significant factor affecting litters per mated female per year is nonproductive days. The best opportunity for improving throughput and minimizing nonproductive days is by reducing the interval from weaning to insemination. Even with older weaning ages, greater throughput can be achieved if the breeding female is pregnant within 5 days after weaning. Areas to focus on when reducing nonproductive days include sow feeding programs, body condition, insemination techniques, estrus detection, pregnancy detection, gilt pool management, weaning age, parity distribution, and sow mortality and culling.

Breeding technique and conception rate: Assuming the sow herd is reproductively healthy and fertile semen is provided, conception rates are most greatly influenced by the breeding technician and his/her heat detection methods and insemination technique. It is not surprising that there are dramatic differences among breeding technicians for reproductive performance. Technicians need an adequate knowledge of physiology and anatomy in order to make prudent decisions while inseminating females. Careful training of personnel charged with breeding the females, coupled with tracking their performance and a program for continual process improvement, can increase throughput. Reproductive performance also tends to be higher on farms that achieve a higher percentage of multiple matings.

Another concern is what is referred to as insemination fatigue. It appears that farrowing rates may decline when individuals are presented a large number of females in estrus at a given time. Strategies should be in place to detect and correct this potential problem. The development of a standard routine with rest breaks after 10 to 15 sows is suggested.

Research has also shown that reproductive performance of females and boars on farms where the animals have little fear of humans is higher than on farms where animals are fearful of humans, so proper

Table 1. Productivity measures to maximize throughput.

		PigChamp Datashare Summary[a]		
Productivity Measure	Suggested Value	Mean	Upper 10 %	Lower 10 %
Pigs weaned/mated female/year	> 19	19.1	23.3	17
Nonproductive days	< 60	74	47	103.5
Weaning age, days	< 24	18.2	21.1	15.2
Farrowing rate, %	> 80	75.6	84.8	64.1
Number born alive	> 10.0	10.3	11.1	9.5
Average sow parity	> 3.5	3.5	4.3	2.7
Pre-weaning mortality, %	< 14.0	13.4	8.7	17.7
Multiple matings, %	> 95	83.4	99.5	66.7
Sow mortality, %	< 8.0	7.8	3.2	13.1
21 day litter weight, lb[b]	> 120			

[a] Data for 2003 reported from 199 U.S. farms
[b] Not reported in PigChamp Annual Datashare Summary

handling of animals can impact herd performance.

Heat detection: Careful heat detection is essential to minimize the number of nonproductive days and the weaning-to-insemination interval. Failure to detect estrus or to breed a sow when in heat will automatically add another 21 days to the number of nonproductive days. Heat detection is very labor-intensive and time-consuming, so most operations do not check heat more than once per day. What becomes more important is the thoroughness and quality of the heat detection when performed. It is important to remember that each female is an individual and will show slightly different signs of estrus. Systematic and consistent heat checks enable one to become familiar with the normal situation of all females and when it changes to estrus. The standing reflex is enhanced by intense periods of boar exposure. However, prolonged boar exposure may result in habituation and fatigue. Boars should be used to check for estrus in small groups. If the boar is placed in the alley in front of the sow, then estrus detection is a two-person job: one handles the boar and the other checks the sow.

Weaning age: Weaning age is another important factor that influences the litters per mated female per year, but to optimize overall reproductive efficiency, weaning age must be set at an optimal level. Reducing the lactation length will decrease the subsequent fertility of the female by extending the weaning to insemination interval, reducing conception rate, and decreasing subsequent litter size. Therefore, to maximize throughput in an operation, the weaning age must be set where it does not significantly reduce sow reproductive performance. In most herds the greatest impacts on reproduction are observed for lactations of less than 17 days. If a sow is to be rebred, a minimum of three days of nursing are needed to suppress the secretion of LH, avoiding the formation of follicular cysts, or the sow may exhibit erratic estrus patterns or remain anestrus. The impact of shorter lactations can be minimized by carefully monitoring and maximizing lactation feed intake to achieve more than 12 pounds per day.

Sow feeding and condition: Nutrition and feeding management play a vital role in reproductive performance during each phase of the cycle. After selection, the gilt pool should be limit-fed to prevent overfattening prior to breeding, which will impact reproductive performance. For sows the feeding period from weaning through rebreeding is critical to reverse the severe drain on nutrient reserves during lactation to promote conception. However, some level of feed restriction is required to reduce milk flow. Generally, 6 to 8 pounds of feed per day is appropriate.

Nutritional management during gestation should provide planned increases of 80 to 100 pounds for parity 1, 80 to 90 pounds for parity 2 through 5, and 55 pounds for sows greater than 5 parities. These targets should vary according to sow maturity, body weight at breeding, and body condition. Overfeeding during gestation has a well-documented negative impact on feed intake during lactation that results in tissue loss for the sow and decreases her ability to return to estrus.

Sows must achieve maximum feed intake during lactation to maintain their body condition. Extremely thin sows resulting from inadequate energy intake during lactation often experience reproductive failure. A “dip” in litter occurs on some farms for parity 2 sows. The body condition of the sows at parity 1 during farrowing and their management during lactation likely play major roles in whether litter size “dips” in parity 2. Feed intake during lactation can be maximized by increasing feeding frequency, ensuring that feed is fresh, increasing the energy density of the diet, and providing for a constant water supply that can deliver 0.25 gallons per minute.

Parity distribution: Herds with a high throughput also tend to have a higher average parity. Higher average parity will result in decreased wean-to-estrus interval, increased farrowing rate and increased litter size. Parity 1 sows often exhibit a 0.5 to 2.0 day longer wean-to-estrus interval than multiparous sows. Gilts typically exhibit a 10 to 15 percent lower farrowing rate than multiparous sows. The farrowing rate will remain relatively constant from parities 2 to 5 but will decrease with high parity sows. Generally, litter size is also lowest at parity 1, increases up to parity 4 or 5, then tends to level off until it begins to decrease around parity 7 or 8. In addition, younger sows are more susceptible than higher parity sows to increased nonproductive days associated with reduced lactation length. The combination of these factors, along with the investment in breeding animals, demonstrates the need to maintain a higher average parity in the herd, resulting in more females at or near peak reproduc-

tive performance.

Sow mortality and culling: The loss or removal of sows from the herd for nonreproductive reasons will also reduce the overall reproductive rate by increasing nonproductive days and lowering the average parity. Careful selection of replacement females combined with proper management can reduce both the sow mortality and sow culling rates.

Gilt pool management: Effective management of the gilt pool will also significantly reduce to nonproductive days. If the average gilt is bred on her second or later estrus, another 21 to 42 days will be added to nonproductive days. Management of the gilt pool should focus on proper feeding, health acclimatization, boar stimulation, heat detection, and breeding.

Live-born pigs per litter

The contribution of litter size to throughput is important but is not as great as minimizing nonproductive days. While the genetic program plays an important role in litter size, it is important to remember that heritability is only 10 percent. This means that 90 percent of the observed variation in litter size is due to other factors. To maximize the genetic contribution of litter size, a sound genetic improvement program should be followed, along with production and selection of parent females that have maximum maternal heterosis.

To achieve large litter size, sows should be fed to appetite (6 to 8 pounds) postweaning and for the first three weeks of pregnancy. Both high and low feeding levels for the first three weeks may compromise the number of fetuses.

Stress prior to, during, and following breeding can result in higher incidences of embryo mortality. Stress on the female can be in the form of physical stress from handling, interaction with other animals, or heat stress.

Animals should always be handled properly and should not fear their caretakers. It is also important to avoid or reduce sow movement or mixing, especially during critical periods of gestation.

One of the most common mistakes in management is a failure to recognize that during breeding and gestation, females are susceptible to heat stress when temperatures reach and exceed 80 to 85°F for short or extended periods. Heat stress has its most detrimental effect on reproductive performance during two critical stages of the gestation period, the first 30 days and the last 30 days. In the normal breeding female, 30 percent of the potential litter number (number of eggs ovulated) is lost within the first 30 days of pregnancy, making management of the female in the first 30 days critical to producing large litters of viable pigs.

Pre-weaning mortality rate

Mortality among newborn pigs at or soon after birth also represents a major loss of throughput. Pre-weaning mortality is reduced by attended farrowing, a warm and hygienic environment, adequate care and nutrition for the mother, and encouragement of high birth weights.

Table 2. Achieving pigs-per-sow-per-year targets with differing live-born pigs, pre-weaning mortality, and litters per sow per year.

	Litters per sow per year = 2.5								
	Pre-weaning mortality, %								
Born Alive	4	6	8	10	12	14	16	18	20
12	28.8	28.2	27.6	27.0	26.4	25.8	25.2	24.6	24.0
11.5	27.6	27.0	26.5	25.9	25.3	24.7	24.2	23.6	23.0
11	26.4	25.9	25.3	24.8	24.2	23.7	23.1	22.6	22.0
10.5	25.2	24.7	24.2	23.6	23.1	22.6	22.1	21.5	21.0
10	24.0	23.5	23.0	22.5	22.0	21.5	21.0	20.5	20.0
9.5	22.8	22.3	21.9	21.4	20.9	20.4	20.0	19.5	19.0
9	21.6	21.2	20.7	20.3	19.8	19.4	18.9	18.5	18.0
8.5	20.4	20.0	19.6	19.1	18.7	18.3	17.9	17.4	17.0
8	19.2	18.8	18.4	18.0	17.6	17.2	16.8	16.4	16.0
	Litters per sow per year = 2.3								
	Pre-weaning mortality, %								
Born Alive	4	6	8	10	12	14	16	18	20
12	26.5	25.9	25.4	24.8	24.3	23.7	23.2	22.6	22.1
11.5	25.4	24.9	24.3	23.8	23.3	22.7	22.2	21.7	21.2
11	24.3	23.8	23.3	22.8	22.3	21.8	21.3	20.7	20.2
10.5	23.2	22.7	22.2	21.7	21.3	20.8	20.3	19.8	19.3
10	22.1	21.6	21.2	20.7	20.2	19.8	19.3	18.9	18.4
9.5	21.0	20.5	20.1	19.7	19.2	18.8	18.4	17.9	17.5
9	19.9	19.5	19.0	18.6	18.2	17.8	17.4	17.0	16.6
8.5	18.8	18.4	18.0	17.6	17.2	16.8	16.4	16.0	15.6
8	17.7	17.3	16.9	16.6	16.2	15.8	15.5	15.1	14.7
	Litters per sow per year = 2.1								
	Pre-weaning mortality, %								
Born Alive	4	6	8	10	12	14	16	18	20
12	24.2	23.7	23.2	22.7	22.2	21.7	21.2	20.7	20.2
11.5	23.2	22.7	22.2	21.7	21.3	20.8	20.3	19.8	19.3
11	22.2	21.7	21.3	20.8	20.3	19.9	19.4	18.9	18.5
10.5	21.2	20.7	20.3	19.8	19.4	19.0	18.5	18.1	17.6
10	20.2	19.7	19.3	18.9	18.5	18.1	17.6	17.2	16.8
9.5	19.2	18.8	18.4	18.0	17.6	17.2	16.8	16.4	16.0

CALENDAR OF EVENTS

February 2006

14 **Northeastern Regional Pork Conference**
Edenton, N.C.

15-16 **North Carolina Pork Conference**
Greenville, N.C.

February-March

27-1 **Pork 101**
Iowa State University
Ames, Iowa

March

2-4 **2006 Pork Forum**
Kansas City, Missouri

The easiest way to decrease pre-weaning mortality is to have a stockperson present during farrowing. Obviously, the additional labor costs associated with this service must be balanced against the potential gain. Through attended farrowing, struggling piglets find the udder and are able to consume adequate colostrum. In addition, piglets that would be crushed can be placed in a safe spot under a heat lamp until they are able to compete for a teat.

Providing a proper thermal environment is the second most critical aspect in reducing pre-weaning mortality. Ensuring that the sow is not too hot and that the piglets are warm can be difficult. However, success in both areas will allow the sow to have maximum feed intake, providing the piglets with greater nutrition and ensuring they will be more able to combat the challenges of malnutrition and disease.

A clean environment also goes a long way in providing a disease-free state for both the sow and the piglet. Sow health cannot be overlooked. Unhealthy sows, lame sows, and sows with pressure sores are less likely to be adept at lying and responding to their piglets and thus have a higher incidence of crushing.

Summary

Swine farms with a high throughput maximize litters per mated female per year by minimizing nonproductive sows days, maintaining good breeding and management programs, and promoting a large number of live-born pigs. They also tend to have a higher average parity, lower sow mortality, more than two matings per service, and pre-weaning mortality that is less than 14 percent. However, these factors should not be the focus of efforts to maximize throughput unless the number of nonproductive sow days and conception rates are already under control.

While not addressed in detail here, the relationship between health and reproduction is crucial. Often the next biggest mistake is assuming that all decreases in reproductive performance are associated with a disease or health status. A drop in reproductive performance or failure to achieve throughput targets can be influenced by all of the factors discussed here. —M. Todd