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Weaning 11 pigs per sow and increasing wean weight: protocols and techniques

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Introduction

The USA swine industry continues to increase productivity of the sow farm as measured by PSY. Genetic improvement and health control are two important reasons for this improvement, but in our view, management is the key factor that has influenced these results.

As PSY improves, production systems continue to reset new targets for on-farm production. One of the new production targets that is commonly discussed for measuring sow farm performance in the USA is:

- Weaning 11 pigs per sow
- Increasing the weight of individual pigs weaned to meet a minimum weight and to increase the average weight of the wean group.

This paper will discuss the on-farm procedures and protocols to wean 11 pigs per sow and the techniques used to increase piglet weight at weaning when weaning larger litters.

Definition of pigs weaned per sow

The PigCHAMP mathematical formula for pigs weaned per sow is:

$$\frac{\text{All pigs weaned from sows with lweandate in the period}}{\text{Number of lweandates in the period}}$$

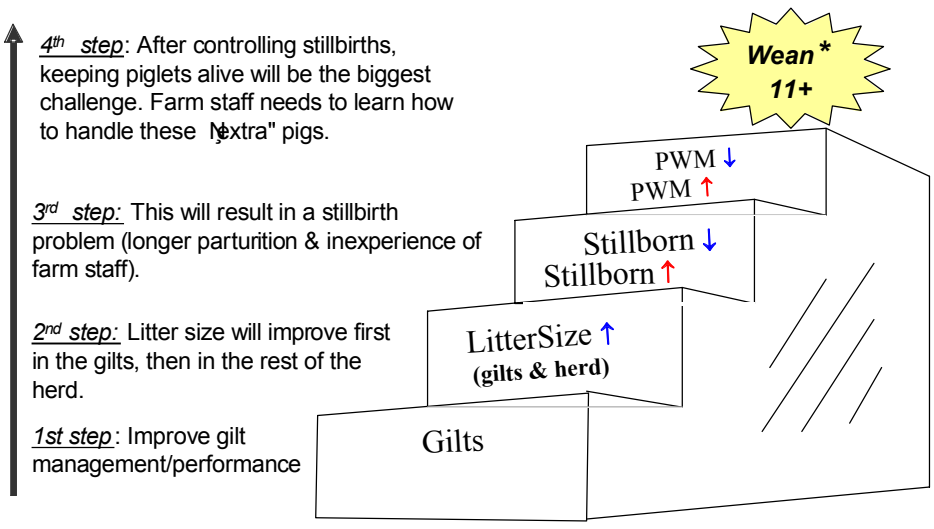
NOTE: All pigs includes pigs from Part Wean and Wean events and excludes pigs from Nurse Off Events in the numerator. The lweandate quantity used in the denominator includes Nurse Off Events if no other Nurse On Event follows. This allows the program to correct for the pigs that are subsequently weaned from Nurse On litters over time. This is the best that can be calculated for the pigs weaned per female per year from the litters per female per year. Lweandate is the date of the last Wean event in the parity record. (Source: PigCHAMP manual, 1996).

For our purposes, we have used the PigCHAMP formula and definition given above of pigs weaned per sow to set all targets and protocols.

Part 1 Weaning 11 pigs per sow: the stairway to progress

It is important to help the farm staff and owners understand and accept that weaning 11 pigs per sow is achievable. Once this has been completed, the staff needs to be educated on the 4 steps of progress and the sequence in

Figure 1: Stairway of progress



*Final challenge will be to improve weaned pig quality & reduce variation

which they occur. For example, as litter size increases, stillbirths may also increase and the staff needs to be prepared to respond to this new challenge. The same will occur with Prewean Mortality % (PWM%), as liveborn increases and stillbirths are controlled, the new challenge becomes keeping all these pigs alive.

Are all sow farms prepared to wean 11 pigs per sow? In our experience, the answer is categorically no! The reasons may vary from farm to farm on why they are not prepared to wean 11 or why they are not meeting this new production target. It depends on what step they are on in **Figure 1** described above. It is important to understand the following points:

Start with large litters

The relationship between total born/born alive and pigs weaned per sow is obvious – as live born increases, there should be a correlating increase in pigs weaned. If the target is to wean 11 pigs per sow we need to achieve at least 11.9 born alive with a 7% prewean mortality (PWM%) as a target. This means that total born should be over 12.5 with a conservative level of mummies and stillborns (5%).

In our experience, and as several authors have demonstrated, everything starts with the gilts. There is a positive correlation with litter size in first parity females and sow productivity in subsequent parities (Edwards, 1997, Patterson, 2004).

A proper gilt program includes genetic line selection, gilt acclimatization, puberty induction, nutrition and breeding management to achieve 12.5 or greater total born. Our field experience has revealed the performance improvement that results when the gilt program described has been properly implemented (**Figure 2**).

In order to capture the full value of the properly implemented gilt program, it is critical to control body condition in gestation to obtain 15 – 16 lbs of weight gain prior to farrowing, and to provide adequate management in farrowing to prevent excessive weight loss (goal: less than 35 pounds of weight loss in P1s during lactation, Neil, 1996). Prevention of fat and/or thin sows results in; increased sow longevity, improved performance in the next parities and an increase in lifetime productivity to over 50 piglets.

The impact of people

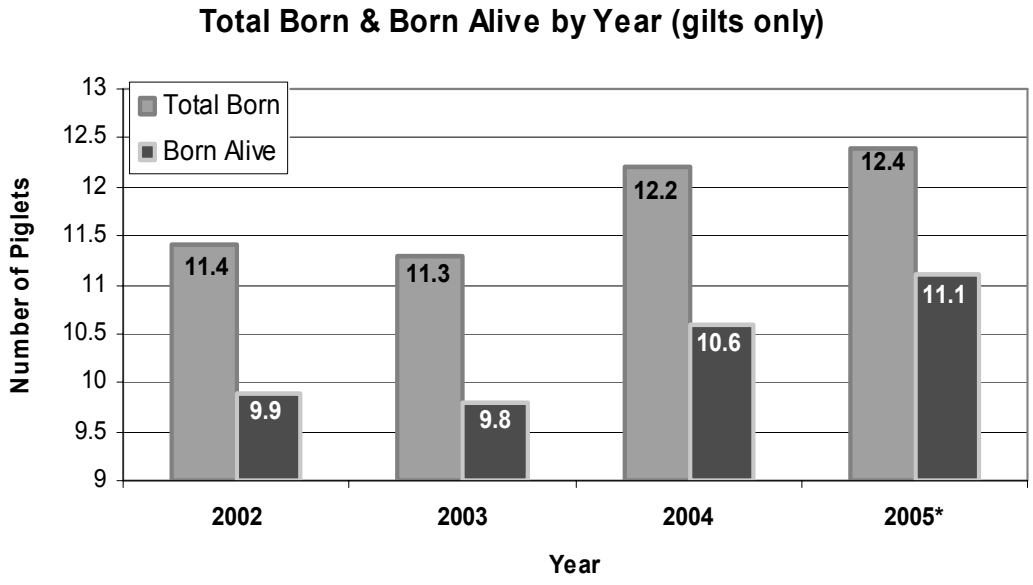
Even with high born alive and perfect protocols, farms may not be able to wean 11 pigs per sow if they do not have the right farm staff. It is important to understand that this includes both the number of employees and the quality of the employee.

The farm staffing level should be determined according to:

a. The design of the on-farm facilities. Some farms have excellent design and equipment that allows for a smaller staff to complete daily tasks. Other, poorly designed farms need a larger staff in order to complete the same tasks. For example, automatic lactation feeding versus hand feeding in lactation may influence staffing levels in the farrowing area and the availability for staff to work in other areas.

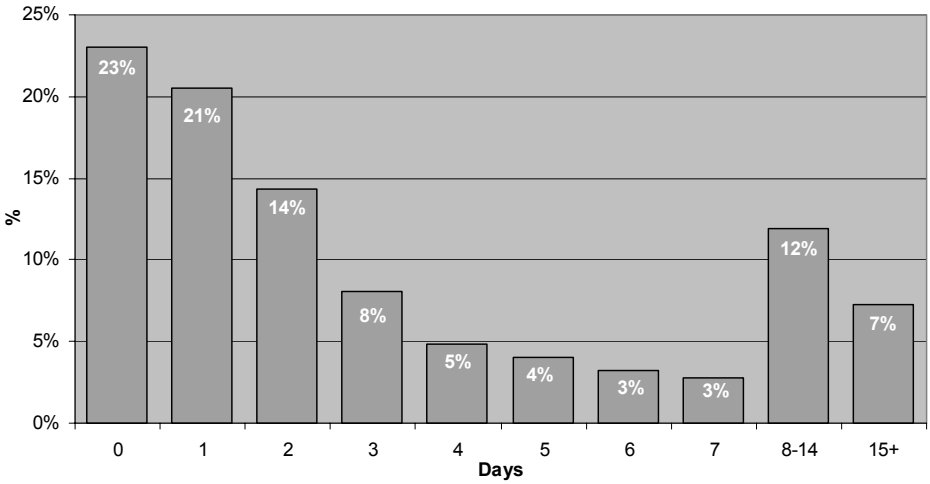
b. The on-farm farrowing protocol. In order to achieve the goal of weaning 11 pigs per sow it is important to assist the sow at farrowing and foster piglets every day reducing the early mortality which is the where the opportunity exists on most sow farms. The majority of piglet mortality occurs during the first 3 days of life (**Figure 3**), therefore it is important to focus the protocol and the staffing resources on this critical time period.

Figure 2: Total born/born alive in 25,000 sow system (gilts only)



(Source: Pizarro, Kerber-Aldous & Spronk, 2006)

Figure 3: Distribution of mortality by day of age (110,000 sows system)



Day 0: Day of farrow (as defined by completion of farrowing)
(Source: Pizarro, Kerber-Aldous & Spronk, 2006)

Table 1: Economic justification of extra person in farrowing in 3400; sow unit with 9 employees

	Year	Week	Goal
3400 sows unit-1 year period			
Total sows farrowed	7381	142	142
Pigs born alive	85,579	1646	1660
Average born alive/litter	11.59		11.69
No. sows weaned	7317	141	141
Total pigs weaned	76,447	1470	1544
Pigs weaned/sow	10.4	10.4	11.0
Pig deaths	9124	175	116.2
Pre-weaned mortality	10.7%	10.7%	7.0%
Economic justification			
Extra wean pigs			59.26
Pig market value	$33.40		$1979.34
Farrowing person cost/yr	$36,000.00		
Pay back in	4.17	months	

(Source: Pizarro, Kerber-Aldous & Spronk, 2006)

However, it is important to realize that the owners and/or managers of the farm predetermine how labor will be allocated when they set the labor budget. By not fully understanding the importance of correctly allocating farm staff, they may be making a determination of how many dollars of the labor budget are available to spend in the first 3 days of a pigs life. In other words, in a tight labor budget, there is no room to allow increased hours to be spent on a protocol focused on these first 3 days of the piglet's life. We strongly believe that an "extra" person allocated for early care in the first 3 days has a high rate of return (**Table 1**).

Equally important is the evaluation of the quality of farm staff. Anyone who manages a sow farm recognizes that a good farm manager makes a difference in achieving production targets (Minion, 2005). In farrowing, there are different activities that are time consuming and non-technical (power washing, process litters, etc), while other activities require higher levels of education and training (farrowing assistance and fostering) that are more technical. Any system and management team should keep this in mind when making personnel decisions. In order to capture all of the potential of quality employees, select the right people and "fit" their skills and experience level into either technical or non-technical positions.

Understanding sow and piglets physiology

To achieve a normal level of PWM (7%) there should be an understanding of the physiology and behavior of the sow and piglets. This interaction between the sow and her litter is well documented (Verstegen, Moughan, 1998; Muirhead, Alexander, 1997, English, 1999), however, for this discussion we will consider and agree upon the basic concepts in order to keep it simple for farm staff to

implement and replicate. Once these concepts are clear and understood, protocols that match behavior and physiology may be set. Some of these basic concepts that we consider important in our protocol are:

Colostrum

- Colostrum is essential to future health and growth potential of all pigs and should not be wasted
- ALL pigs need colostrum.
- The pigs ability to benefit from colostrum is gone by 18hrs.
- The sows ability to produce colostrum is gone by 24hrs, but colostral production is reduced by 50% just 6 hrs after farrowing.

Piglets

- Piglets are susceptible to hypothermia and hypoglycemia.
- Newborn piglets have very limited reserves of energy. These reserves must be boosted by intake of colostrum
- Pigs are establishing their teat order on the sow within 12hrs after birth. Every piglet move after 12 hours = STRESS on the sow and the pigs.
- Strongest piglets claim the more popular teats (front of the udder).
- At 6 hours of age some piglets claim their teat. By 12 hours this process is completed.
- When these piglets are fostered off to another dam they have to go through the whole process of re-establishing teat order. This results in increased fighting, energy consumption and stress.
- Two piglets can not possibly share one teat and expect to do well.

Sows

- Sows let down milk every hour.
- Milk let down only lasts 15 to 30 seconds.
- The last portion of the milk evacuated from normal uninterrupted suckling has a higher fat content
- Unused mammary glands take 3 days to dry off.
- Mammary glands inactive in one or two lactations may have full milk yield in subsequent lactations (Gut-á Porta, 2004).

Setting the right protocol

The challenge when any on farm production protocol is established is:

- To make the protocol clear and simple so that everyone from the owner to the farm staff understands it.
- To set targets to measure execution of the protocol.
- To be certain the farm staff is educated according to the protocol and the protocol itself is an educational tool (i.e. the protocol explains why).

Many times we set protocols that are not realistic and the farm staff is confused and frustration sets in. Protocols can be different between farms, systems and countries based on the reality of each separate farm, system or country. Here in USA, where we do not have staff on the farm 24 hours a day, the biggest challenge is the amount of time that employees can spend in farrowing. The time allocated to assist sows and piglets needed to achieve our production goals (11 pigs weaned per sow) is limited by this reality. This may be frustrating to farm staff since in farrowing, the task list is never completed as opposed to the tasks in gestation or the GDU, i.e. the work in farrowing is never finished.

We have based our farrowing protocol on two key concepts:

- Achieve a high percentage of farrowings during the time period when staff is present (establish an effective induction program).
- During work hours, 100% of the time, a staff person is in farrowing (early care).

In order to achieve the above, and to adhere to the previously discussed physiological principles, the most important protocol points are:

- Records and Classification: as a first step, set a clear classification for the reasons of piglet mortality and target a "normal" distribution that farm staff can understand.
- Farm staff administration: start with early care and accountability. At least two people assisting sows and piglets in the first 3 days, one assisting sows to reduce stillborn pigs and the other doing split suckling and fostering. After day 3 of age, the rooms are transferred to the next farm staff "owner" who is accountable for the room until the pigs are weaned.
- Break policy: someone is always in the farrowing rooms, even during the employee breaks. Managers organize the farm staff in order to achieve 100% of coverage during normal work hours. Stillborns are not acceptable for sows farrowing during this period.
- Preparing & Loading rooms: the manager is accountable to check and approve each room before farrowing crates are "loaded". They focus on dry/warm crates and rooms, proper control settings, heat lamp placement and water nipples functioning properly. Farrowing kits are prepared and ready to be used when sows begin to farrow in the room. The "best crates" in the

room are strategically allocated for potential nurse mothers and P0s are placed in a predetermined area of the room.

- Induction Program: "more farrowings during the day = more opportunities for live pigs" Always measure; always evaluate the day/night farrowing ratio. Goal; greater than 65% of farrowings during normal "business hours".
- Daily Priorities: employees are educated on the importance of prioritizing their daily tasks. One of the most important moments in the day is every morning when employees first arrive in farrowing. First, a quick evaluation of the situation must be made, and then priorities are set. The different scenarios that an employee may encounter when first arriving in farrowing are shown in **Table 2**.
- Early care: A specialist is needed in this position to focus on these key concepts:
  - "Wet fostering": this is the best opportunity to reduce stress of fostering and achieve colostral intake – if still wet, the piglet has not yet established a teat order. Fostering is done between sows during the process of farrowing. Health protocols may limit use of this technique during PRRS "breaks".
  - Drying the piglets: while everyone understands the importance of dry pigs in regards to thermoregulation and that dry pigs have a higher rate of survival, efficient methods to accomplish this task effectively vary from farm to farm. Bottom-line; have tools available for farm staff to get the pigs dry as quickly as possible!
  - Split suckling: in large litters when no other litters are available to reallocate piglets, use this technique. Piglets that are in excess of the number of teats are placed into a box or tub in order to allow the remaining pigs to obtain adequate colostrum. After 1 1/2 hours, the piglets in the box or tub are placed back onto the sow and the corresponding number of pigs are removed from the sow and placed into the box or tub. Piglets are marked to be sure that all piglets have received adequate opportunity for colostral intake.
  - Extra colostrum: collected and administered with a syringe and tube (gastric tube is recommended) 10 ml. of colostrum minimum in smaller, viable piglets.
- Fostering: to obtain adequate colostral intake, and to reduce risk of chilling and malnutrition, this is the most effective technique to reduce PWM% and increase growth rate prior to weaning.
  - Prioritize litter integrity. According to the udder and teat conformation.
  - Main concept "do not remove a pig from a litter until you know where will be relocated".
  - Large/Medium/Small concept: classify piglets and sow's udder before moving ("smart fostering").
  - Recheck the litters on day 5 to 7 in order to evaluate piglets for any signs of starvation, but avoid "over moving". This is a common mistake, too many pigs are moved during the lactation period resulting in lower than expected wean weights.
  - Refill teats that are open (due to death loss) with piglets that begin to starve.
  - Use weaned sows as nurse mothers in problem litters.
- Focus on death loss due to "laid-ons"; the main reason piglets die in the first 3 days of life.
  - Be sure to set the right environment.
  - Heat lamps: set in correct position to achieve 93-94 F degrees for the newborn piglet.
  - Mats: keep the mats dry and clean.
  - Focus labor during the first 3 days of life.
- Sow & piglet treatment; identify and treat earlier. In sows, focus on leg injuries and fever, avoiding over

Table 2: Different scenarios that an employee may encounter when first arriving in farrowing

Scenario	Action
• Sows that are done farrowing.	• Evaluate size of piglets vs. udder.
• Large litters (12+).	• Split suckle.
• Small litters (11 or fewer).	• Fostering piglets according to the number of piglets and weight.
	• Colostrum, colostrum, colostrum.
• Sows not done farrowing with dry pigs.	• Needs help! Intervene! Assist! Sleeve!
• Sows that are in the middle of farrowing normally.	• Keep watching them.
	• Fostering depending of size-udder relationship.
• Sows that are not beginning to farrow.	• Evaluate induction according to the protocol.

treatment. In piglets, focus on early scours. Record treatments on the sow cards in order to track response to treatment.

- Sow Feeding: help the farm staff to understand the difference between AM and PM feedings. Educate the staff on the importance of high levels of feed (energy) intake in the first 7 days of lactation. "Push" sows to eat more by analyzing sow feeders especially in the PM feeding. Goal: achieve 75 lbs of lactation intake per sow in the first 7 days of lactation.

Farm history

In late 2005, we set new on farm production targets of 11 pigs weaned per sow. A pilot farm was selected and new protocols implemented to achieve this new target. The pilot farm was a 3400 sow breed to wean facility in the Midwest USA. The farm had 9 full time employees and a history of high live born (greater than 11.0) and high prewean mortality (12%). The protocol was implemented in week 5 of 2006 and results are shown in **Figures 4** and **5**. A PRRS break in week 14 disrupted production trends, but current results show that piglet death loss trends are returning back to normal levels and the target to wean 11 pigs per sow will be met.

Results from the implementation of the protocol to wean 11 pigs per sow from the pilot farm will be used to finalize a protocol to be implemented across all sow farms. Once the goal of weaning 11 pigs per litter is achieved, the next goal will be to increase the wean weight of the pigs. Part 2 of this paper will outline the steps that we have taken in anticipation of this problem.

Part 2 Increasing piglet wean weight

Accomplishing the goal of "Weaning 11" is a futile effort if we merely produce more pigs but fail to generate more income to the farm due to poorer piglet quality at weaning

Figure 4: Average born alive/wean per sow by week (2006)

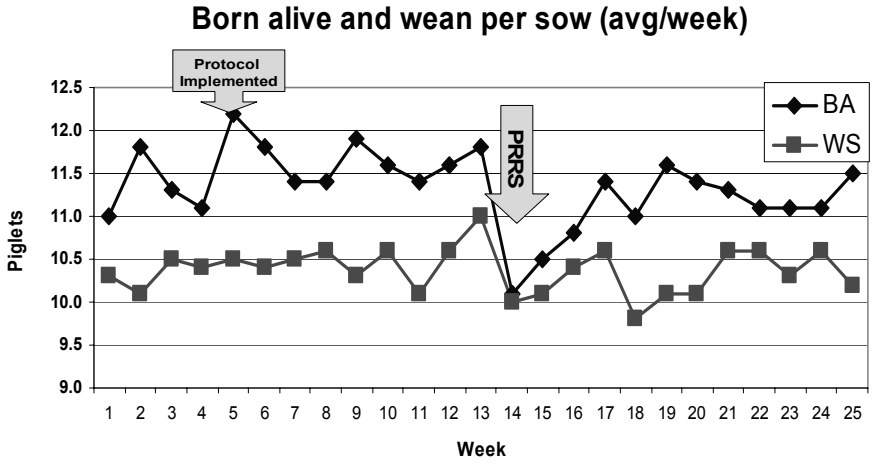
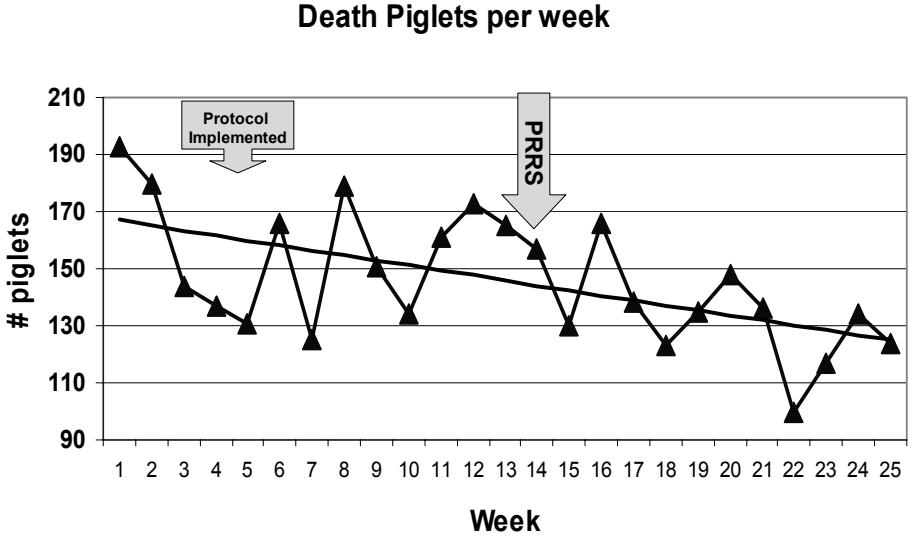


Figure 5: Total number of deaths by week (2006)



(i.e. more small pigs). Therefore, it is equally important to implement management strategies that will improve the weight gain of low birth weight piglets and reduce fallouts, particularly as progress continues to be made in litter sizes of commercial sows. The relationship between weaning weight and litter size was demonstrated in the analysis of PigChamp records by Koketsu and Dial (1998), in which the average weaning weight declined substantially in litters with a born alive of 11 or more (**Figure 6**).

Furthermore, the piglet's demand for milk and its resulting ability to gain weight is far greater than the sow can support. In fact, by day 8, the sow's milk output has been demonstrated (Boyd et al., 1995) to be less than that needed to support maximum piglet growth (**Figure 7**).

The additional demand put on the sow to nurse large litters, can lead to greater loss of body reserves, particularly in a warm environment when feed intake and milk output is reduced (Azain et al., 1996). Wean to service interval and subsequent total born have been demonstrated to be negatively affected by lactation weight losses of just 5%-10% (Thaker 2004). Therefore, it is also important to consider management strategies that can have an impact on the subsequent performance of sows nursing large litters.

A study was conducted within our system in the spring of 2006 to evaluate the application of milk supplementation to improve the quality of piglets weaned to downstream, producer-operated nursery/finishers. The main objective of the study was to reduce the number of piglets weighing less than 8 lb. at weaning (non-revenue pigs), while also evaluating the potential impact of milk supplementation on prewean mortality and subsequent performance of the sows, as measured by wean to service interval and total born.

Individual piglet weights at birth and weaning were collected for 2476 piglets within 220 litters allotted to either control or milk supplemented (MS) treatments.

MS litters within each room were offered milk replacer via a Crown Cup(τμ) within the farrowing crate starting 24 hours after birth and continuing through weaning. Treatments were equalized within each farrowing room and an equal number of gilt litters were allotted to each treatment within each of 10 rooms.

The percent of piglets weaned weighing less than 8 lb. was reduced ($p < .05$) by 50% while weaning weight was improved ($p < .05$) by more than 1/2 lb. per pig (**Table 3**). Although a numerical reduction in prewean mortality was

Figure 6: The influence of litter size on piglet weaning weight from PigCHAMP records

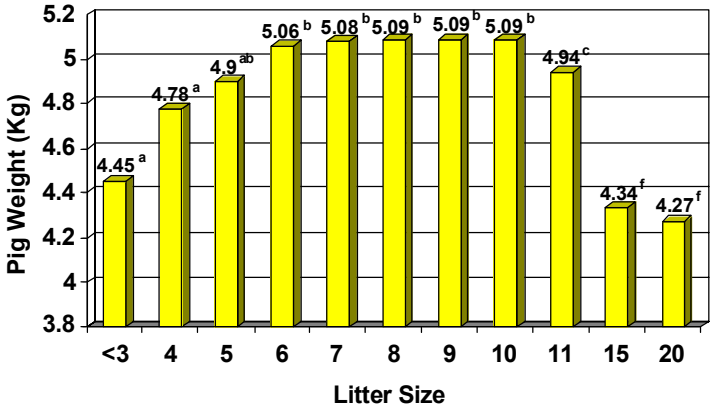


Figure 7: Daily milk intake of pigs reared artificially as compared to calculated milk production of the sow

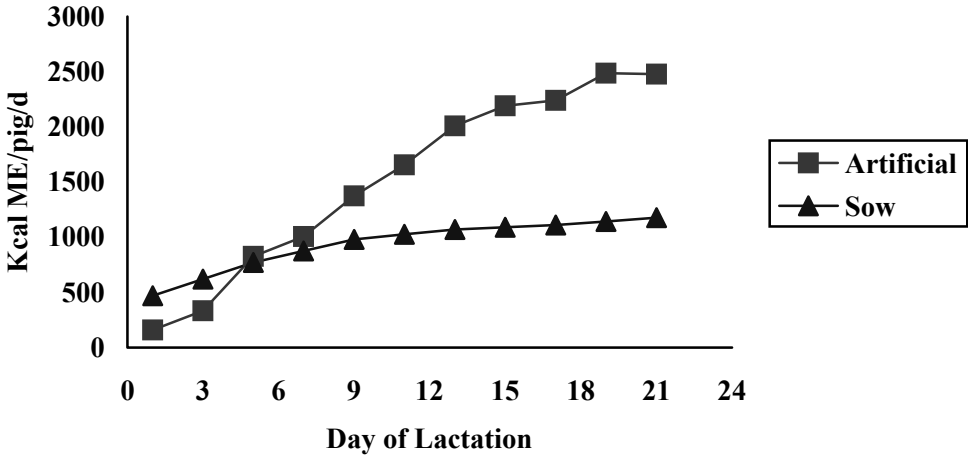


Table 3: Sow farm results

	Non-supplemented	Milk supplemented	Mean	SE Mean	Total
Ave. Parity	2.49	2.63	2.56	0.16	
Pigs Placed/Litter	11.18	11.32	11.26	0.06	2,476
Ave. Birth Weight, lb	3.45	3.45	3.45	0.02	
Pigs Weaned/Litter	10.26	10.41	10.34	0.09	2,272
Ave. Weaning Age, days	19.97	20.09	20.03	0.03	
Ave. Weaning Wt., lb	13.46	14.09	13.78	0.06	(P < 0.05)
% Weaned < 8# BW	4.30	2.08	3.17	0.003	(P < 0.05)
Prewean Mortality, %	8.37	8.04	8.20	0.01	
Milk per Pig, lbs	-	0.65			
Milk Cost/Pig, $	-	0.75			
Milk Cost/Litter, $	-	7.76			
Full Value Wn Pigs/Litter*	9.90	10.12			

*based on the average pigs weaned/litter of 10.34

Table 4: Preliminary nursery results

	Non-supplemented	Milk supplemented
Ave. parity of dam	2.31	2.47
Ave. birth weight, lb	3.38	3.45
Ave. wean age, days	19.78	19.86
Ave. wean weight/weight in, lb	13.08	13.81
estimated ADG, lb	0.85	0.89
Ave. weight out, lb	51.2	53.9
Mortality, %	0.9	1.8
Mort. + Pigs received < 8 lb, %	5.5	3.9
Ave. Nursery days	45	
Overall ADFI, lb	1.36	
Overall F/G	1.59	

observed for MS piglets, the relationship was not statistically significant. The supplemented piglets had nearly 1:1 milk: gain conversion. Subsequent performance of the sows will be analyzed when the data becomes available.

Approximately 1300 of the weaned pigs were penned separately by treatment and followed through a commercial nursery. At the end of the nursery phase, the MS pigs had a 2.7 lb. advantage (**Table 4**). Mortality and ADG data will be collected through the finishing phase for this group of pigs.

In practice, then, we can use this data to select piglets for supplementation on a more limited basis, thus greatly improving our return on investment. By selecting the lightest 35% of the piglets at birth, we would expect to achieve the same 50% reduction in non-revenue pigs at weaning (**Figure 8**).

Previous research by Boyd and others reported a significant reduction in prewean mortality for milk-supplemented litter, particularly for litters nursed by third parity or older sows. We observed a similar trend of lower prewean mortality for milk-supplemented litters. Therefore, milk-supplementation could be targeted to reduce fallouts, particularly in older parity litters where prewean mortality is increasing (**Figure 9**).

By targeting 55% of the piglets (35% low birth weight and 20% older parity sows) our milk cost is then reduced from $7.75/litter weaned to $4.30/litter weaned. A 50% reduction in non-revenue pigs yields .22 additional revenue piglets/litter. For this farrow to wean farm, the additional piglets are worth $7.26 per litter ($33.00 x .22), which brings us to a return over milk cost of $2.96/litter or $0.29 per pig weaned. We would also anticipate maintaining a portion of the increase in weaning weight which would become a benefit via either reduced days to market or increased market weight.

Figure 8: The relationship between birthweight and the percentage of non-revenue piglets at weaning for milk supplemented piglets as compared to non-supplemented

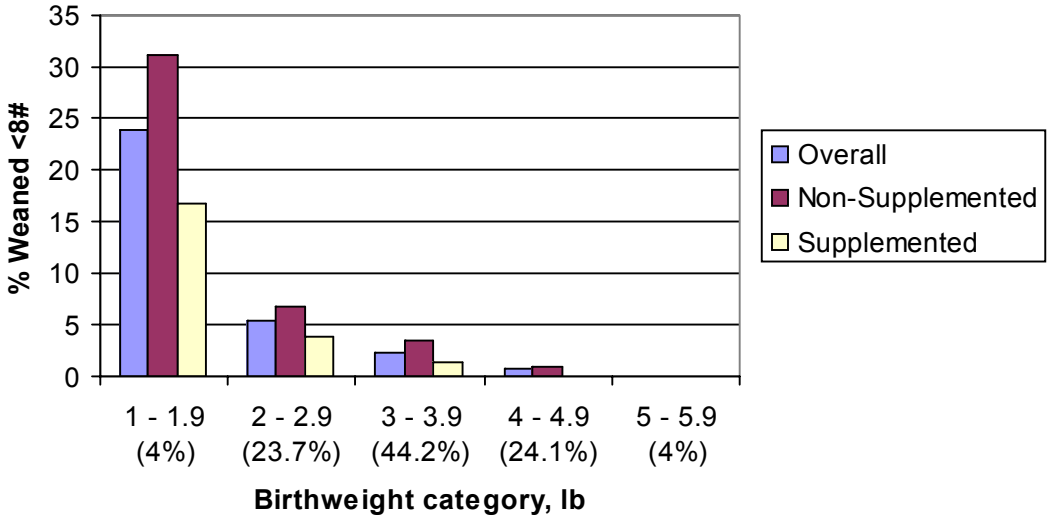
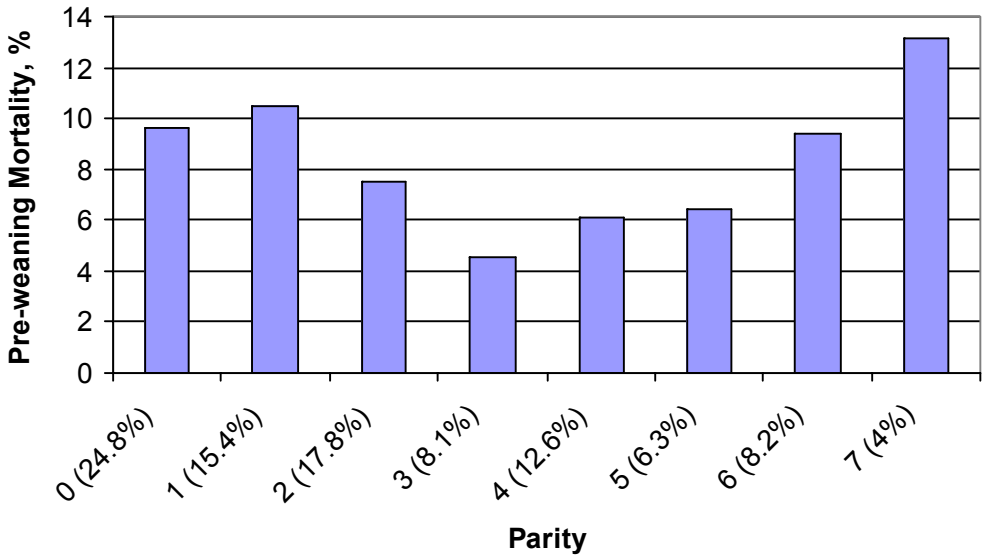


Figure 9. The relationship between piglet mortality and sow parity



Milk-supplementation provides an economical way to increase the number of full revenue piglets weaned. Further research is needed to evaluate the responses observed in this trial in warmer months.

Discussion

Weaning 11 pigs per sow and increasing the wean weight of the group are the new production targets been established on many USA sow farms. These new targets are attainable but require new levels of administration and management techniques.

In our experience, the greatest hurdle to achieve these targets are; health of the herd, people and administration of new protocols and technologies.

Farms and management teams that can overcome these hurdles will be successful in achieving new levels of farm production.

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