EXTENDING SOW PRODICTIVE LIFE: THE SCIENCE BEHIND CURRENT PRACTICES DESIGNED TO MAXIMIZE BREEDING HERD IMMUNITY

R.B. BAKER, DVM, MS
SENIOR CLINICIAN, FSVS-SWINE SECTION
COLLEGE OF VETERINARY MEDICINE, IOWA STATE UNIVERSITY

There is very little scientific information on the relationship between immunity and sow productive life. Productive life is a derived average coming from record systems. Few studies have followed individuals or even groups of sows assessing health and immunologic parameters over complete life cycles. All of our data is based on culling practices and the evaluations of those who are involved in production; those having little knowledge of immunologic causes for reproductive failure, acute and chronic illness, or premature death. There is a total insufficiency of knowledge connecting immune status with lifetime productivity and longevity. We have little or no insight supporting most culling practices especially where it concerns acute health challenge that often precipitate chronic affliction – this leading to culling or death. All of these decisions are made on the basis of age, ambulatory/locomotor ability, weight/condition, or prior reproductive and lactation performance. None accurately reflect immune issues or status. By the same token all of these factors are significantly influenced by individual health and immune robustness.

Our diagnostic laboratories are primarily involved in the service business, never in an active discovery role. We test for what we already have knowledge of, what is economically significant, where automated procedures allow rapid and electronic reporting; we give the customer what they desire –quick results. There are no dollars to chase a new syndrome unless a crisis is at hand. During the mid 1990's sow productive life made a substantial "nosedive" compared to past and current data. The transition to modern housing and to the so called "industrialized production model" had occurred more than a decade prior to escalating sow mortality and excessive culling. We missed an emerging infectious disease and the agent or agents that led to this phenomenon. It is also apparent that nutrition, poor husbandry/management, PRRS virus, influenza, over selection, and improperly motivated genetic programs had an influence on this syndrome but the missing link is the infectious agent that precipitated this conference.

We currently attempt to maximize the immune status of our breeding herds through a number of practices including fecal and placental feedback, "serum therapy", cool downs, acclimatization, autogenous and commercial vaccines and other black magic practices. This is chiefly an attempt to homogenize colostral transfer to piglets and to maximize breeding performance. We have an arsenal of vaccines for sows. PRRS, Lepto, Influenza, Erysipelas, Parvovirus, E.coli, Clostridia, to name a few. Most of these are designed to protect the embryo, fetus, or suckling piglet. Those that have opportunity to maximize sow survival and productive life are directed at RNA viruses and have little opportunity to derive broad immune protection. Much like RNA viruses of other species, repeated exposure to variant isolates leads to aggressive and misaligned immune response precipitating enhanced pathology. We have failed to maximize herd immunity in a meaningful manner. We have failed to maximize sow immunity and for that matter sow robustness in a way that appreciably improves longevity and productive life. Most if not all sow productive life issues are related to health and health challenges.

Rodney Butch Baker, Iowa State University College of Veterinary Medicine, 1710 Vet Med Building, Ames, Iowa 50011-3020, PH: 515-294-3837, EM: rbbaker@iastate.edu.

SEGREGATED PARITY STRUCTURE IN SOW FARMS TO CAPTURE NUTRITION, MANAGEMENT AND HEALTH OPPORTUNITIES

R. Dean Boyd,[1] Noel Williams,[2] and Gary L. Allee.[3] [1]The Hanor Co., Franklin, KY; [2] Pig Improvement Company, Goodletsville TN; [3] University of Missouri, Columbia MO.

This paper describes the rationale for organizing sow farms into 2 sub-populations for age-based feeding, in order to achieve the potential for life-time pig output. The premise is that the amount and type of nutrients differ so much for young immature sows (first 2 litters) when compared to mature and aging females (> 5 litters). It is clear that nutrition specific to the first litter female improves 2nd litter-size. It appears that a different application of nutrition improves pigs weaned in mature sows. Arrangement of sows into 2 sub-populations is possible for existing sow farms, provided that a mental road-block is not constructed and 'cemented' with old paradigms. The arrangement is based on nutritional considerations, but we believe that it compliments health (and reproductive) strategies with respect to PRRS, mycoplasma pneumonia and piglet enteric disease.

The first litter female (P-1) is especially vulnerable to body protein loss during lactation. The foremost consideration is to formulate and feed to conserve body protein loss since there is a direct effect on wean to estrus interval (WEI) and second litter-size. For example, a 4 kg (8.8 lb) body protein loss, during first lactation, is sufficient to reduce second litter-size by 0.75 pigs. In contrast, limiting protein loss to less than 2 kg (4.4 lbs) can result in a 1.0 increase in litter-size, compared to the first. Thus, WEI increases in proportion to body protein loss (R^2 0.63).

The mature and aging female is at risk for a premature decline in litter-size with advancing parity, but for different reasons. Total pigs born and born alive increase to the 3rd litter, then are constant until about litter 5 or 6; thereafter, a progressive decline is observed. This parity related decline in litter-size for the prolific sow seems premature from a reproductive perspective. The lost opportunity is estimated to be in the order of 1.8 to 3.3 pigs per sow life-time, depending on whether productive life-time is 8 or 10 litters. Our data suggests that this is due in part to the progressive decline in micro-nutrient nutrition (vitamins, trace minerals) intake per lb body weight, as the sow ages. Sow viability may be at greater risk, but this has yet to be proven. Amino acid nutrition and body protein loss is not at issue based on our data.

Organization of the sow herd into a 'young' sub-population, consisting of P-0 through P-2 (2 litters) and a 'mature' sub-population, consisting of P-3 through P-10 (3rd - 10th litters) is a reasonable approach to address the very different nutritional needs of respective sows. The outcome is improved life-time pig output by producing a large first litter and then to manage her in a manner that allows for a further increase in 2nd litter size (more rapid 'climb' to maximum at 3rd – 4th litter). Once P-1 females are successfully re-bred (P-2) and managed to 60 d pregnant, then the need for specialized 'young' sow Nutrition probably ends. However, we believe that there are health-based reasons for keeping these sows in the 'young' sow sub-population. Although the decision to include P-3, 4 sows with the mature and aging sows is driven by the need to reduce gestation and lactation diet cost, our data suggests that the 'premature' decline in pigs born and weaned can be addressed through improved micro-nutrient nutrition. Thus, the axiom of 1 gestation and 1 lactation diet is well overdue for change since this practice, albeit easy, has imposed a 'silent' financial cost on systems utilizing Prolific sows.

Boyd, R. Dean. Director of Technology, The Hanor Company, Franklin, KY 42134. Telephone: 608-588-9658; email address: dboyd@hanorusa.com.

PARITY SEGREGATION OF PRODUCTION FLOWS TO IMPROVE PROFIT: WHAT WE HAVE LEARNED

R. Dean Boyd,[1] Bob Meurer[2], Tara Donovan[3] and Dave Wade[3]. [1]The Hanor Co., Franklin, KY; [2]Roberts Ranch of Oklahoma and [3]Spring Green WI.

This paper presents the results of a commercial experiment involving segregated weaned pig production flows from (1) young (1st litter) and (2) older sows (2nd litter and greater). The primary objective was to determine if this approach would improve pathogen control, reduce disease and system veterinary cost. This experiment was the result of pioneering work of C. Moore (2001) illustrating the potential to do so. In the course of this large scale study, we verified the extent to which male pigs die in relation to females pigs and this difference is increased significantly when health becomes unstable, in both the nursery and finish phases. The importance of lactation length on progeny performance was also documented (Cabrera et al., 2001). This paper provides more reason for re-organization of the sow herd into 'young' and older (non-primiparous) sub-populations.

Segregation means to separate something for *special* treatment. Segregation formats have pathogen control as their main objective. Examples of formats include: medicated early wean (progeny separated from sow herd), multi-site production (ages separated) and AIAO. This report is devoted to a 4th format, involving parity segregation. It has potential advantages for life-time pig output (sow reproduction; *see keynote address this conference*) and for the health of weaned progeny. This type of segregation receives most of the present emphasis.

An important axiom to bear in mind is that '. . . the presence of <u>higher</u> <u>risk</u> animals does affect the <u>rest</u> of the population and <u>cause</u> higher mortality than low risk animals' (Dr. J. Deen, personal communication). The quality of pigs at entry to the nursery is described to a large extent by these factors: (1) gilt derived progeny, (2) pigs >30% below the mean wean weight, (3) pigs less than 15 d of age (vs 20 for example), (4) sow farm source and (5) gender.

The young sow has an inherent problem in that her progeny are more susceptible to pathogens, die to a greater extent and have a greater medication cost. Their removal from the progeny of older sows (2nd litter and up) can reduce medication cost (water, feed, injectable) by up to 40-50%, for the older sow progeny. We have recorded a 20% decrease. The mortality rate for young sows is 30-40% higher (W-F) despite increased medical cost, but a solution is unclear. Gilt-derived progeny weigh ca. 10 lbs (4.5 kg) less after 160 d post-weaning than those derived from sows. This necessitates variable time (vs fixed time) facilities use to minimize a further loss in profit potential. Sow farm is another significant source of medical cost and output loss (lbs marketed/sow/year). A progeny composite from multiple sow farms (2 or more) simply does not work, even when Isowean™ is employed. It is our view that Isowean™ has not worked in practice and even conflicts with important benefits from longer lactation lengths (>20 d). However, Isowean™ technology is important to pathogen 'cleanup' on sow farms. The increased mortality of male pigs (castrate or intact) relative to female pigs is especially apparent when growing pig health becomes unstable. This result remains, albeit is less dramatic, when health is under 'control'. The increasing trend toward longer lactation length (eg. 20 vs 14 d) is justified. Not only is the number of pigs weaned/sow/year improved, but progeny growth, viability and carcass lean are also improved. The net effect of this research was to reduce medication cost/pig marketed by 20% with less dependence on antibiotics. The ability to improve viability of 1st litter progeny and male pigs is significant but not resolved to this point.

Boyd, R. Dean. Director of Technology, The Hanor Company, Franklin, KY 42134. Telephone: 608-588-9658; email address: dboyd@hanorusa.com.

Behavioural implications for sow longevity

Laura Boyle, Moorepark Research Centre, Fermoy, Co. Cork, Ireland

According to Hurnik and Lehman (1988) there is a direct correlation between an organism's well-being and its lifespan or longevity. That is to say that the better an organisms needs are satisfied the longer it may be expected to live. Or in the case of the sow, the longer her productive lifetime is likely to be. A sows 'needs' can be divided into life, health and comfort sustaining needs. There are several examples of sow behaviour that provide clear indications of a failure to satisfy certain needs. The difficulty involved in 'weighting' different comfort sustaining needs means that their implications for sow welfare are the subject of much debate. Nevertheless it is very likely that "persistent long-term failure to satisfy comfort-sustaining needs may have consequences which are worse for individuals than temporary failure to satisfy even health-sustaining needs" (Hurnik and Lehman, 1988). 'Worse consequences' can be interpreted as premature death or removal from the breeding herd leading to a reduction in sow productive lifetime.

The three main areas of sow behaviour that have potential links to reasons for sow death and disposal are (1) posture changing behaviour; (2) aggressive behaviour and (3) farrowing and maternal behaviour. Problems or abnormalities in the performance of these behaviours can be linked directly or indirectly to injury, locomotor disorders, reproductive failure, disease and poor performance all of which are major reasons for sow disposal (Boyle et al., 1998).

Today's sows are much larger than they were 30 years ago. However the dimensions of most gestation stalls in use are based on Baxter's estimations of sow size made in 1984. Space restrictions cause posture changing difficulties particularly in late gestation when the sows morphometric dimensions have increased by between 7 (length) and 53% (width). Indeed recent research indicates that stall-housed sows are immunosuppressed in late gestation when posture changing is most encumbered. This could have implications for disease susceptibility. Sows that are too wide for their stall are often forced to dog-sit as an intermediate position between standing and lying. This posture is a risk factor for urinary tract infections which are associated with reproductive performance and death. Posture changing difficulties in stalls and indeed in farrowing crates are also reflected in lesions to the skin of the limbs and in extreme but not altogether rare cases, to amputation of accessory digits. Posture changing difficulties in farrowing crates are implicated in the problems of low lactation feed intake, development of pressure sores, leg disorders and piglet mortality. The influence of mats and gestation housing system on posture changing behaviour of sows in crates is discussed. It is recommended that space allowances for sows in gestation stalls and farrowing crates are urgently revised upwards.

Although aggressive behaviour is rare in free-living pigs it is necessary when unfamiliar pigs are placed together in unnatural combinations and in unnatural environments in order to establish the dominance hierarchy. Indeed it is difficult to reduce aggression between sows at mixing although there are many ways in which the results of aggression such as injuries and foot damage can be reduced e.g. through use of specialised mixing pens or provision of hide areas. Once the dominance hierarchy is established aggression arises due to competition for access primarily to food, but also to other preferred resources such as comfortable lying areas. While elevated cortisol and catecholamine levels arising from aggression are related to stress, the implications of social stress for reproductive performance are equivocal. It is likely that the negative effects of group housing on reproductive performance is not a direct consequence of aggression *per se* but is mediated though a combination of low feed intake and a high level of social stress in low ranking sows. This emphasises that higher levels of aggression in group compared to individual housing need not necessarily result in impaired reproductive performance provided that management and housing/feeding system minimises individual variation in feed intake and ensures the protection of the more vulnerable animals in the group.

The risk of a sow leaving the herd due to disease, injury or death is highest in the peri-parturient period. Undoubtedly parturition is very stressful for all animals but there is evidence that the frustration of nest building behaviour exacerbates the stress response in pigs. Furthermore, several studies have shown negative implications for the course of parturition, subsequent sow maternal behaviour and consequently for piglet survival. Nest building behaviour by sows in farrowing crates can be facilitated by the provision of nesting materials such as straw or even tassels. However, results to date from studies with sows in commercial units show few if any benefits in terms of piglet survival. Implications of changing the degree of confinement between gestation and farrowing accommodation on sow behaviour at farrowing are discussed. There are gaps in our knowledge as to the effects of the persistent attention directed by piglets towards the sow as lactation progresses on sow maternal behaviour.

In conclusion, aspects of sow behaviour provide clear indications of our failure to satisfy their health and comfort sustaining needs and this has direct/indirect implications for sow longevity. By addressing these behavioural problems not only will sow productive lifetime, but also sow health and welfare be improved.

Laura Boyle, Teagasc – Irish Food and Agriculture development Authority, Moorepark Research Centre, Fermoy, Co. Cork Ireland, PH: 3532542389, EM: Laura.Boyle@teagasc.ie

Sow Housing Update

Discover Conference on Sow Productive Lifetime

Steve Brier, Midwest Sow Production Manager
Murphy-Brown LLC

Group housing during gestation has been a much debatable topic worldwide the few decades. With the recent announcement of Smithfield Foods and other companies, the strategy and method to phase-out of gestation stalls is critically important to the U.S. swine industry. The biggest challenge discontinuing gestation stalls will be to identify and implement sustainable solutions while maintaining sow productivity and minimizing associated costs. The pros and cons of the three group housing methods (free-access pens, electronic feeders, and drop feeding) will be reviewed. Factors influencing the method selection will be discussed and planned solutions for Smithfield Foods' company-owned sow operations.

Steve Brier, Murphy Brown LLC, PO Box 393, Nevada, MO 64772, PH: 417/667-3397, EM: stevebrier@murphybrownllc.com

A Snapshot Analysis Look Into Herd Retention

Matt Culbertson, PhD
Smithfield Premium Genetics Group

Although herd structure and retention is critical for ideal sow herd and growing pig performance, sow retention rates have not been commonly measured in many commercial pig farms. As an important opportunity area for future creation of sustainable business performance and competitive advantage more in-depth understanding of constraints and solutions to sow retention is needed.

To aid in base understanding, we conducted a data mining analysis of sow operations across multiple states and ownership type. Our objective was to better understand and quantify differences in sow retention. The sow operations included were all production systems that were generally static in sow inventory and replacement rates over the one-year period of data analyzed. Sow operations included in these analyses ranged from 3 to12 farms and from 7,500 to 50,000 sows.

These data suggest the largest variation between farms in sow retention rates occurs from the time select gilts enter the breeding pool through her second farrowing event. The rate of sow attrition from the second farrowing through the sixth litter was generally similar across farms. These data suggest that limiting the attrition of selected gilts to 10% per parity cycle may be a reasonable benchmark.

Improving sow retention represents a significant opportunity to enhance sow herd and production system efficiencies. Additional understanding is needed to optimize the genetic, nutrition, health, environment and management factors needed to consistently deliver exceptional performance.

Matt Culbertson, PhD, General Manager, Smithfield Premium Genetics Group, PO Box 668, Rose Hill, NC 28458. Phone: 910-282-4283. E-mail: matt.culbertson@spgenetics.com

Sow Productive Lifetime:
A Measure of the Sow's State of Being

Stanley E. Curtis, University of Illinois

- State of Being = condition of existence: well, fair, poor
- Successful coping = adaptation; unsuccessful coping = stress

- Stress related negatively with animal performance
    - Generally productive performance first, then reproductive
    - Gilts still growing (productive), but in sow, decreased reproductive performance shows up right away.

- Effects of simultaneous stressors mostly additive
- Reduction in even one stressor reduces total stress
- Performance very quick, very sensitive indicator of stress

- Performance reflects stress
- State of being reflects stress
- So peformance reflects state of being

- Genetic improvement of sow reproductive traits: difficult, slow
- To reduce variation in sow reproductive traits and upgrade sow reproductive performance: improve environment

- Variation in sow productive lifetime does reflect variation in sow state of being

- Fundamental mechanism involved: in a zero-sum situation, redirection of metabolizable energy from reproductive functions to adaptive mechanisms (maintanence functions)

- The Performance Axiom

- Measures of sow productive lifetime can be used as indicators in assessment of sow state of being

Stanley E. Curtis, University of Illinois, 2305 Brookens Circle, Urbana, IL 61801, PH: (217) 344-4811, EM: securtis@uiuc.edu

Sow Productive Lifetime – Have we a Problem?

John Gadd

The extent of the problem.

Figures on sow longevity from the records of nearly 200 of the speaker's clients, Europe and world-wide between 1999-2007, suggest that achieving between 3.4 and 4.1 litters are the norm, when obtaining 6 should be achievable with modern genotypes, feeding and management knowledge.

The cost of the shortfall.

Using European economics of 2007, the speaker provides figures which show that such performance reduced the potential lifetime income per sow by 32% to 43%. Such a reduction in cash flow has a significant effect on both the annual investment value/sow and gross margin/sow, especially in pig industries where costs are high/production is sophisticated or capital-intensive.

Where may the problem lie?

From this on-farm advisory on hundreds of pig farms the speaker outlines 18 primary areas which have affected the shortfall, and eagerly looks forward to hearing the views of Conference on how they can be tackled.

Where should research go?

To assist him and his clients, 8 areas are put forward for consideration.

John Gadd, Scallow Cottage, Parsonage Lane, Fontmell Magna, Shaftesbury, Dorset SP7 OPB United Kingdom, PH: 0044 17478 11409, EM: Johnngadd@aol.com.

Modeling the Economics of Sow Longevity

Dr. Derald Holtkamp, DVM, MS; Iowa State University

Introduction

This paper describes a whole herd budgeting approach for evaluating the economics of different culling patterns in breeding herds. Specifically, the production and economic impact of a gilt management program that influenced sow longevity is evaluated. Both the breeding and growing pig herds are modeled. The gilt management program involves exposure of gilts to vasectomized boars in finishing beginning at 145 days of age followed by an isolation period of six weeks with no boar exposure. Gilts are then moved to pens in the breeding herd and finally to stalls 5 to 7 days prior to administration of MATRIX® (Intervet) for 14 days. Additional boar exposure is provided during this time. At the end of that 14 day period the gilts are returned to pens with fence-line boar exposure. Gilts found in heat are bred in the pens. Gilts not found in heat by 10 days after treatment with MATRIX® ceased are treated with PG 600 in an effort to induce estrus.

Methodology

The herd level measure of sow longevity used is this analysis is a distribution of removals by parity or "removal parity distribution" (Figure 1). Each parity is modeled as a separate population and then aggregated to report outcomes for the entire herd. The outcomes are driven by parity differences in several key productivity measures in the breeding herd, cost of replacement females, salvage value of cull animals and key productivity measures in the growing pig herd. The economic outcomes are summarized as differences between the alternative removal parity distributions associated with pre and post implementation of a gilt management program.

Results

The total net benefit of the gilt management program is $27.59 per female per year (Table 1). The economic benefit of the program is divided into those due to 1) cost of replacement less the salvage value of culled females, 2) breeding herd productivity and 3) growing pig productivity.

Derald Holtkamp, Iowa State University College of Veterinary Medicine, 1710F Vet Med, Ames, Iowa 50011-3020, PH: 515-294-9611, EM: holtkamp@iastate.edu

Figure 1. Removal parity distribution pre and post gilt management program

	Percent of females removed in parity (% of all removals)	
Parity	Higher early culling scenario	Lower early culling scenario
0	26.7%	18.9%
1	18.2%	13.5%
2	6.5%	7.0%
3	4.9%	6.1%
4	4.9%	6.1%
5	4.9%	6.1%
6	5.8%	7.3%
7	5.8%	7.3%
8	5.8%	7.3%
9	7.3%	9.1%
10	5.3%	6.7%
11	3.9%	4.8%
SUM	100.0%	100.0%

Table 1. Economic outcomes ($/breeding female/year)

	Pre-Program	Post-Program	Difference
Cost of replacement gilts less salvage value of culled females			
Cost of replacements purchased ($/year)	$124.34	$104.01	
Salvage value of females culled ($/year)	$101.30	$89.49	
Cost of replacements purchased net of salvage value of females culled ($/year)	$23.04	$14.52	$8.52
Breeding herd productivity			
Total annual cost of production($/year) Less cost of replacements purchased net of salvage value of females culled	$566.81	$566.72	
Annual revenue from weaned pigs ($/year)	$586.53	$597.54	
Total annual profit from weaned pigs ($/year) Excluding cost of replacements purchased net of salvage value of females culled Excluding cost of replacements purchased net of salvage value of females culled	$19.71	$30.82	$11.10
Growing pig productivity			
Total annual cost of production($/year)	$2,025.72	$2,064.10	
Total annual revenue from market pigs ($/year)	$2,312.40	$2,358.75	
Total profit ($/year) Excluding cost of replacements purchased net of salvage value of females culled	$286.69	$294.64	$7.96
Total			$27.59

NUTRITION OF THE DEVELOPING GILT FOR OPTIMAL LIFETIME PRODUCTIVITY

Lee J. Johnston, University of Minnesota

Productive life of sows in most commercial systems is shorter than desired. A shortened productive life reduces potential profits for pork producers and is likely a sign of compromised sow welfare. Consumers are becoming more aware of and vocal concerning welfare of sows and pigs in general. Consequently, it is important to gain a better understanding of factors that influence productive life of sows and how those factors might be managed to lengthen the productive life of breeding sows.

Reproductive failure and lameness or locomotory problems are the most common causes for sow losses in commercial production units. Many factors could precipitate these problems. Recently, proper preparation of gilts for entry into the breeding herd has received renewed attention as a potential influencer of sow longevity. Historically, most research has focused on various aspects of the growing-finishing phase as they relate to puberty expression and first litter performance. Very few studies have considered the effects of gilt development on lifetime productivity. Therefore, researchers, pork producers and their advisors are required to base their gilt development programs on very few controlled studies with a large dose of practical experiences and observations.

An effective gilt development program that focuses on improving sow longevity must consider growth rate of gilts from birth to herd entry, body composition of gilts at first mating, skeletal integrity, structural correctness or fitness of the gilt, sexual age at first mating, and economics. Based on the current limited body of evidence it appears that sow longevity will be enhanced if growth rate of gilts from birth to selection is controlled to between 600 and 700 g/d. Gilts should be mated on their second estrus at a body weight of at least 135 kg but not more than 155 kg. At selection (about 160 days of age), gilts should be evaluated for soundness of structure and locomotion, mammary soundness and proper development of the reproductive system. This approach will allow additional time for skeletal development, decrease the proportion of gilts with extremes in body weight or body fatness, and ensure females are physically fit for the rigors of successive pregnancies and lactations.

Efforts to enhance sow longevity do not end with properly-developed gilts. Females can be ruined resulting in early exit from the herd by improper management after they enter the herd. The best way to optimize a gilt development program and reap the rewards of careful gilt management is to implement all economically feasible technologies aimed at optimizing sow performance.

To date, gilt development programs have focused on nutrition and management of females after 25 kg body weight. Some researchers have suggested that physiological factors during the suckling period may influence lifetime productivity. One might speculate that pre-natal development could affect lifetime productivity. These areas await more in-depth exploration in the future.

Lee J. Johnston, West Central Research and Outreach Center, University of Minnesota, 46352 State Hwy 329, Morris, MN 56267; Phone: 320-589-1711; Fax: 320-589-4870; E-mail: johnstlj@morris.umn.edu;

Locke Karriker *
Iowa State University College of Veterinary Medicine
1710C Veterinary Medicine
Ames, IA 50011
PH: 515-294-2283
EM: karriker@iastate.edu

INFLUENCE OF STOCKPEOPLE AND BOARS ON LIFETIME REPRODUCTIVE PERFORMANCE OF MULTIPAROUS SOWS – PRACTICAL METHODS AND NEEDED RESEARCH

Donald G. Levis, University of Nebraska-Lincoln

Stockpeople. The owners of sow farms are finding it increasingly difficult to hire and maintain good stockpeople. Many farms are at a crisis point in terms of staffing their units. Good stockpeople are highly prized because they have a huge influence on the health, welfare and reproductive performance of the sow herd. High quality workers are thinkers and self-confident, self-motivated, team players, problem solvers, have good observation skills, pay attention to details, and are eager to learn. Workers should not be treated as robots! The following attributes of the workers have significant consequences on sow longevity: Attitude, behavior towards pigs, skills to perform job, knowledge about job, team building spirit, job satisfaction, and fatigue during insemination process. Fatigue during insemination has been found to have significant effects on the number of pigs produced by specific technicians. If inseminator technicians use an improper number of sperm cells per dose and improper techniques during actual insemination process, sows will have a higher probability of being culled.

Boars. Although the majority of sow farms now artificially inseminate sows, the boar still plays a key role in sow longevity. A major role of a boar that is often overlooked relates to his ability to stimulate estrus in weaned sows and to stimulate a solid standing response to boar stimuli (sight, sound and smell). If the sows are not accurately detected in estrus, they may not be inseminated at the correct time. If the mating is on a repeat sow, she will most likely be culled. If sows are improperly heat-checked and inseminated, they may have a reduced farrowing rate and litter size. A second role is the production of viable sperm cells that are capable of fertilizing the ova. A substantial amount of variation exists between boars in their ability to produce viable sperm cells. The use of heterospermic semen (mixing of two or more boar's semen prior to packaging in doses) may or may not enhance farrowing rate and litter size. Some combinations of heterospermic semen may have detrimental effects on reproductive performance of sows.

Needed research. Although there is a lot of information available about how to hire and maintain workers, there remains a high turnover in workers on many sow-farms. Evidently, the solution to the hiring and maintaining high quality employees has not been found. How do owners of sow farms get employees to think in terms that they are a significant and needed link in the chain for the sow farm to be highly successful. With respect to boars, it appears that a weak link is the selection, development and management of heat-check boars. Research needs to continue on ways to identify highly fertile boars. Although environmental effect most likely play a significant role in sow longevity, is there a significant genetic component of the sire on sow longevity?

Donald G. Levis, Professor of Animal Science and Extension Swine Specialist, Haskell Agricultural Laboratory, University of Nebraska-Lincoln, 57905 866 Road, Concord, NE 68728-2828; Telephone: 402 584 3816; email: dlevis1@unl.edu

ON-FARM TRAINING AND DAILY SCHEDULING TO OPTIMIZE SOW CARE

Timothy J. Loula, DVM, Swine Vet Center

The swine industry has changed from primarily all family labor to predominantly hired labor. This labor often has little or no previous swine or livestock experience and requires more training as well as more *effective* training.

This presentation reviews and demonstrates many of the "basics" of training as well as the use of new high-tech tools available today to effectively train new staff members.

Training must be precise, clear and short. Fact sheets, SOP's and checklists are commonly used short yet detailed 1-page pieces. Visual aids including PowerPoint, video clips and interactive modules are becoming increasingly common training methods.

Understanding your employees and the level of training they need in order to have a highly productive work force is critical for success in today's swine industry.

Tim Loula, Swine Veterinary Center, 1608 S. Minnesota Ave., St. Peter, MN 56082,
EM: tloula@swinevetcenter.com.

MANAGING INDIVIDUALS IN LARGE POPULATIONS TO INCREASE LIFETIME PRODUCTIVITY

J.F. Lowe, DVM, MS – Albers, IL

This presentation will attempt to answer key questions surrounding the management of individuals to increase their lifetime productivity. The first of those is "what is the value of lifetime performance" and therefore why should managers devote the most precious of all resources, time, to attempting to increase it. Secondly, can a systematic approach to animal management increase lifetime productivity? A majority of the presentation will focus on real world examples of management strategies that have been used to increase the productive lifetime of sows.

An increase in lifetime performance by increasing productive lifetime will decrease the number of primiparous sows farrowing in any system. This reduction will increase the value of the weaned pigs to the production system though increased consistency in weight, parasite (both micro and macroscopic) load and subsequent growth rate.

Strategies to improve lifetime performance include attention to individual body condition management, lactation feeding strategies, and proper gilt selection and management. These strategies will be discussed in detail during the presentation.

James Lowe, Carthage Veterinary Service Ltd., 34 West Main, Carthage, IL 62321, 309/336-1006, 217/ 357-6665, EM: lowe@hogvet.com

GOT MARKERS?
RETIRING SOWS AT AN OLD AGE

Scott Newman
Genus/PIC North America

Sow productive life (SPL) comprises a complex suite of traits influenced by both genotype and environment. Quantitative genetic studies have shown evidence for genetic variation in length of productive life and other associated biological characters (e.g., stayability, leg conformation). Attention has begun to focus on molecular aspects of SPL. An understanding of the genes controlling various aspects of SPL will help reduce unexplained variability in SPL, shed light on underlying systems and processes, and identify individuals who possess helpful or harmful genotypes associated with SPL.

There is a large body of literature associated with the study of genetic pathways of lifespan and aging in model organisms (yeast, nematodes, mice) as well as humans. Mutations in genes associated with DNA repair and regulation, inflammation, stress resistance, insulin signaling, and caloric restriction have been associated with increased (or decreased) longevity.

Mote, Stalder and Rothschild *(2007; Discovery and validation of genetic markers for sow longevity. Final report submitted to the National Pork Board*) used these pilot organism studies as the basis for evaluating 20 genes dispersed throughout the swine genome associated with longevity, nutrition, health, growth, reproduction and inflammation processes. Among other results, they showed that (1) number of days in the herd was greatly influenced by environment/management (in this case farm), and (2) at least three genes studied (CCR7, CPT1A, and IGFBP1) significantly affected certain aspects of both survival and reproduction to a particular number of days in the herd or parity.

Candidate gene association analyses and eventually whole genome scans will make it possible to identify relationships between single nucleotide polymorphisms (SNPs) and biological traits associated with SPL. Systems biology tools such as proteomics and metabolomics will in the future help provide understanding of the way genes interact as well as underlying biological mechanisms. The extension of current BLUP theory to accommodate whole genome selection will allow increased accuracy to breeding value estimation. However, the use of this information in genetic improvement programs will still require sound breeding objectives and is still in its infancy.

Scott Newman, PIC North America, 100 Bluegrass Commons Blvd., Suite 2200, Hendersonville, TN 37075. Tel. +1 615 265 2781, email scott.newman@pic.com

GILT ISOLATION AND ACCLIMATION MANAGEMENT

Dale W. Rozeboom and Barbara E. Straw
Michigan State University

Managing the gilt's transition from "growing" to "reproducing" is critical for maximizing production efficiencies of the swine enterprise. Inadequate number of farrowings and number of live born piglets is costly. Isolation and acclimation are two practices which may be used increase the success of introducing gilts to reproduction and their home in the breeding herd.

Isolation or quarantine, involves keeping incoming replacement gilts away from the breeding herd for a time to prevent them from giving disease to the breeding herd. Distance between isolation and breeding herd facilities, animal care personnel management, and knowledge of gilt and sow current states of health are important for preventing pathogen spread.

Acclimation is the managed time necessary to accustom gilts to a new environment; minimizing stress so that gilts attain a desired reproductive fitness. Acclimation and isolation initially occur simultaneously, with the time required for acclimation generally is being longer than that for isolation. Gilts are acclimated to disease, and to non-disease stressors including: recovery from the stress of transport, housing (i.e. pens, stocking densities, flooring, drinkers, feeders or floor feeding), new pen mates, boar exposure, sentinel sow exposure, serology work, new diet formulations, and vaccinations.

In recent years, acclimation has received increasing attention because of the detrimental effects of PRRS on reproduction in the breeding herd, but the effects of other diseases (influenza, E. coli, and parvovirus) on reproduction also warrant a time of acclimation. Ideally, acclimation to breeding herd diseases only works if you know gilts get the disease for sure (100% of all incoming animals) and the protection of immunity from future infection. But this does not happen practically, so then you get gilts experiencing infection at different times and some even after movement to breeding and gestation. Consequently, the disease becomes active in those phases, affecting other animals which are under stress and have less immunity. If gilts are going to be put into a breeding herd with acute disease, then acclimation may work short-term to lessen the reproductive devastation of the disease. Gilts with infectious disease may overwhelm the immunity of older sows, and cause active outbreaks.

Acclimation does not eliminate PRRS. Closing the herd to new PRRS variants and working to get have a PRRS negative herd is the desired goal. Acclimation would be effective in eliminating PRRS if all animals get sick and recover with immunity. This works for TGE. The best thing with TGE is to expose all animals as quickly as possible and get it over with. Eliminating PRRS may take longer than TGE because the length of time that TGE is carried and shed by sows is weeks vs. months for PRRS virus. Present acclimation practices perpetually maintain infection by giving it to incoming gilts time after time.

Additional research is needed to establish effective isolation and acclimation protocols as much of what we know to-date is anecdotal.

Contact: Dale W. Rozeboom, Associate Professor/Extension Specialist, Department of Animal Science, Michigan State University, 2209 Anthony Hall, East Lansing, Michigan 48824, Ph: (517) 355-8398, Fax: (517) 432-0190, Email: rozeboom@msu.edu.

REVENUE OPPORTUNITIES IN SOW CULLING

Stephanie Rutten-Ramos, University of Minnesota

There are two basic categories of sow culling—involuntary (i.e., reasons of health/welfare) and voluntary (i.e., reasons of relating to poor performance or old age). Similarly, these classifications could be considered as biological, or forced, culling and economic culling. Assuming everything has being done to minimize animals culled in the first category (i.e., selection pressures, nutrition, health/disease management, etc.), then the second category holds opportunities to improve revenue.

At the farm level, voluntary culling is frequently driven by one of two realities—the availability of gilts and/or the aversion to poor-performing sows. For herds with a strict inventory policy, the standards for voluntary culling will vary according to gilt flow. Without a strict inventory policy, removal criteria may be more consistent, but are still subject to week-to-week variation according to the farm's ability to make breed target.

Further complicating the effectiveness of culling programs is the role of "management." For example, if it is true that a herd under good management could farrow sows at a rate 10% that same herd under poor management, then those sows failing to farrow under poor management are at risk of being culled for reasons other than their own attributes. Similarly, seasonal patterns are also observed in voluntary culling rates.

Although it should be noted that there are likely some discrepancies between the physical and perceived reasons for cull events, inconsistencies in culling program applications offer opportunities to assess the effectiveness of culling decisions.

Determination of the merits of economic culling programs requires answers to a few key questions. First, how reliable are the reasons for which sows are culled? I.e., can herd personnel accurately predict a sow's future performance? Second, does the farm's contextual performance affect the success of a removal/replacement decision? I.e., is the outcome of a removal/replacement decision more reliable when the farm is performing well than when it is performing poorly? And finally—and maybe most importantly, what defines a successful removal/replacement decision? I.e., is success measured terms of sow space productivity, financial impact on the sow unit, or financial impact on the entire system? If the latter is true, then the growth performance of parity one offspring needs to be taken into account. And for units with internal replacement, the role of the parity one female on production of replacement females also needs consideration.

To develop a preliminary estimate of the value of economic/voluntary culling, retrospective case-control analyses of voluntary culling decisions were performed on three separate farms of similar genetic and health backgrounds. Estimates of counterfactual performance were determined for sows removed for reasons of fertility (e.g., no heat, recycle, preg check negative), fecundity (e.g., litter size, low bornalive) and age (e.g., old age/parity). Based on study findings, an economic model was developed to consider herd-level financial impact of voluntary culling in parities 1-6.

In conclusion, although replacements generated more pigs per sow on average, the reliability of the removal/replacement outcome varied considerably across reason, herd and herd context. A model to compare herds employing and not employing voluntary culling in specific parities showed that the older parity structure resulting from non-economic/voluntary culling could offset poorer performance of retained animals.

Stephanie Cara Rutten-Ramos, University of Minnesota, S. 385 AnSci/Vet Med, 1988 Fitch Avenue, St. Paul, MN 55108; 320-886-9413 (ph); rutt0011@umn.edu.

SELECTION FOR SOW LONGEVITY: WHERE WE ARE – WHERE TO GO

Timo Serenius
MTT Agrifood Research Finland, Biotechnology and Food Research, Biometrical Genetics

During the last years, industry has shown increasing interest to select for sow longevity. Thus, breeding value estimation for sow longevity is needed in order to obtain genetic improvement in an efficient breeding program. In general, sow longevity is defined as a time period (days) from first farrowing to culling or death of a sow. However, most of the sows we are interested in are still alive (censored records) at the evaluation time. This makes breeding value evaluation challenging.

In general, there are three type of analysis that can be considered in breeding value estimation of sow longevity. Most widely used and accepted method is survival analysis. Survival analysis are based on proportional hazard models, where longevity is defined as probability of sow being culled at time t, given that she is still alive at time t-1. The most famous survival analysis software among animal breeders is the Survival Kit. The only disadvantage in survival analysis is that multiple trait models are not possible to implement in the practice.

The second alternative for longevity analysis is to treat length of productive life as a right censored Gaussian trait. In this method, data augmentation in Gibbs sampling is used to predict the future length of productive life for censored observations. Right censored Gaussian trait analysis are relatively easy to implement, and multiple trait models are possible. The disadvantage of this method in comparison to the survival analysis is that there is no clear way to model time dependent effects.

The third option is to record sow longevity as a binary variable indicating whether sow reached n^{th} parity or not, and analyze the data using routine animal breeding software. This is simple and easy method to implement, but very ad hoc in the nature as well. However, stayability type of analysis can be improved by generating repeated binary records until sow is culled.

In any case, most studies have concluded that sufficient genetic variation exists for effective selection on sow longevity, and heritability estimates have ranged between 0.02 and 0.25. Moreover, sow longevity has shown to be genetically associated with prolificacy and leg conformation traits. Additional research is needed to identify the most efficient selection methods for sow longevity.

Timo Serenius, Dr, MTT Agrifood Research Finland; Phone: +358 3 4188 3614; e-mail: Timo.Serenius@mtt.fi

Gilt Development Techniques that Alleviate SPL Concerns

Joaquín Spörke, DVM, Asesorías Portec Ltda., Chile

The industry in North America is in the process of turning the industry more competitive. Several actions have being taken in the last few years to accomplish that objective. A big area of opportunity is still the production and cost efficiency of the sow herds. In the last 3 years there has been a substantial improvement in these areas across the industry, increasing the number of wean pigs per farm and per mated female in herd.

There are still opportunities in many systems in areas that have not been addressed in a systematic way: Gilt management and gilt pool management, and high fallout of young parity females with high replacement rate and low productivity in terms of piglets weaned per female lifetime.

The gilts are very important in a pig farm. They count for more than 20% of the farrowings, and in addition to that, how gilts perform will determine many times how that female will perform as a sow in their next parities in the herd. Based on that, a highly productive sow herd starts with a well managed gilt pool. Managing the gilt pool and puberty of gilts has been described since long time ago, but is still an area where the industry has difficulties in realizing and implementing what is already known.

Main objective of gilt management is to have gilts matching the two basic requirements for breeding: weight of 300 or more lbs, and second recorded estrus. To achieve these objectives, adequate estrus induction procedures have to be implemented, with intensive boar exposure and estrus recording process. Implementation of these programs has been a big challenge for the industry.

Systems that have implemented an adequate gilt management program have higher gilt productivity, lower fallout of young parity females, higher sow and herd productivity, and higher lifetime productivity of females. The economic compensation comes from lower cost on keeping a controlled gilt pool, higher productivity and throughput, and lower sow cost producing more weaned pigs during sow lifetime.

Joaquín Spörke, Asesorías Portec Ltda., Santiago, Chile. Tel: (56-2) 214 2238, email joaquin@asportec.cl

EVALUATION of BODY CONDITION and FEET AND LEG SOUNDNESS ON SOW PRODUCTIVE LIFETIME

K. J. Stalder[1], T. Serenius[2], R. Fitzgerald[1], L. Karriker[3], and A. Johnson[1]
[1]Department of Animal Science, Iowa State University, Ames, IA, 50011
[2]MTT Agrifood Finland, Jokioinen, Finland
[3]Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames,

In order to maintain a sow herd that is productive over many parities it necessitates a high degree of management over successive parities. Two of the primary reasons that sows leave the breeding herd include lameness (feet and leg problems, hoof injuries, etc.) and poor body condition. Additionally, the amount of feed consumed during a sow's last lactation prior to culling has been shown to an important factor contributing to an early exit from the breeding herd.

The evaluation of body condition score or the amount of both fat and muscle a sow has at any point in the production cycle is quickly becoming a lost art. A combination of turnover within sow production units and the lack of generational passing of information have created a need for additional tools. These tools are used to train producers and employees within sow production facilities in order that body condition score is accurately evaluated and more importantly sows are properly fed so that they do not overly thin or fat.

Feet and leg problems and lameness continue to be one of the major identifiable reasons that breeding herd females leave the sow herd. Since feet and leg problems are so prevalent in the breeding herd population, it is suggested that we begin with by scrutinizing replacement gilts more thoroughly for feet and leg soundness making sure that we eliminate a replacement gilt candidate that has poor feet and leg structure or some other feet or reproductive soundness issue before they enter the breeding herd. This would include gilts that are purchase or produced in an internal multiplication scheme.

To address this issue, Iowa State University Extension, National Pork Board, National Hog Farmer magazine and several sponsors teamed up to develop tools to help evaluate feet and leg soundness as well as reproductive soundness of replacement gilts. Additionally, a pocket guide, designed to be taken directly into the barns for use were developed. Similarly, a body condition scoring poster was developed which included both English and Spanish translation on the same poster. These tools were designed to address very basic training needs at the barn level so that producers and employees have more knowledge at their disposal to address both body condition scoring of sows and the evaluation of feet and leg soundness and reproductive soundness of replacement gilts with the ultimate goal of improving the productivity and sow productive lifetime within their herds.

Ken Stalder, Iowa State University Department of Animal Science, 109 Kildee Hall, Ames, IA 50011-3150, PH: 515-294-4683, EM: stalder@iastate.edu

GENETIC INFLUENCE ON SOW PRODUCTIVE LIFETIME

K. J. Stalder[1], T. Serenius[2], M. Knauer[1], L. Karriker[3], and A. Johnson[1]
[1]Department of Animal Science, Iowa State University, Ames, IA, 50011
[2]MTT Agrifood Finland, Jokioinen, Finland
[3]Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames,

As is the case with most, if not all, economically important pork production traits, sow productive lifetime is influenced by genetics and/or breeding system. Some of the genetic effects can impact sow productive lifetime through other important traits. It is clear that sow productive lifetime or sow longevity is a trait that is heritable. The degree to which it is heritable may be population dependent and can be sensitive to how the trait is defined and analyzed.

It is also important to understand the current situation both in terms of average culling rates and how we may have gotten where we are at. Today, it is not uncommon to have herds that average over 50 percent replacement rate annually and herd mortality rates average at or above 10 percent in many cases. For many years, the focus of the breeding programs has been to produce leaner animals that grow fast and can provide this performance with relatively little feed inputs. Consumer demands have required that producers provide lean, healthier products for today's more discriminating consumers. I think it is safe to say that US swine breeders and their counterparts worldwide have met the challenge of producing leaner animals. But what has been less quantified is the costs, if any, from a breeding perspective did essentially single trait selection for lean gain cost breeders and pork producers?

When examining why sows leave the breeding herd, it is important to identify those factors that are most commonly associated with a sow exiting the breeding herd early. When these factors have been accurately identified, it gives breeders a chance to develop multiple approaches to improving sow productive lifetime. Selecting can occur on the trait of interest, in this case sow productive lifetime, directly. Alternatively, selection can occur on a secondary trait, for example feet and leg soundness in order to improve sow productive lifetime over the long term.

It is essential to recognize that there are line differences for sow productive lifetime and it is important to recognize the importance that crossbreeding may play for the trait as well. The later is particularly important when a producer is utilizing a great grandparent and / or a grand parent program in an internal gilt multiplication program.

There is much needed research in the area of genetic impacts on sow productive lifetime. A large portion of the data provided in this presentation has some age and may or may not apply to today's modern lean females. Molecular advances hold some promise to assist breeders in improving sow productive life time through the utilization of marker assisted selection. Yet these markers are just now being identified.

Ken Stalder, Iowa State University Department of Animal Science, 109 Kildee Hall, Ames, IA 50011-3150, PH: 515-294-4683, EM: stalder@iastate.edu

Sow Productive Lifetime: Gestation and Lactation Nutrition

Dr. Mike Tokach, Kansas State University

The major impacts of gestation and lactation nutrition on sow productivity are well known. Overfeeding sows during gestation causes excess body fatness at farrowing, which limits feed intake during lactation. Low feed intake in lactation, whether due to excess body fatness or management limitations on feed intake (low feed provided, high ambient temperature, or limiting water intake), causes excess weight loss in lactation which results in decreased subsequent reproductive performance. The exact metabolic mechanisms are unknown, but are thought to be mediated through metabolites and metabolic hormones acting on the brain and reproductive organs. The end result is that overfeeding in gestation results in increased culling due to locomotor problems, reproductive failure, and poor lactation performance. Underfeeding of sows during gestation is not as detrimental, but can result in reproductive failure if the sow has inadequate body reserves at farrowing and fails to consume enough feed to maintain body condition during lactation. The greater problem with underfeeding sows is the welfare concern of thin sows more easily developing shoulder ulcers and other injuries. The energy requirements of sows during gestation and lactation are well understood. The limitation is in our ability to meet the needs of every sow in the barn on a consistent basis. This job will become more difficult as we move to group housing systems. We must focus on providing people in the barns with practical, low input ways of meeting sows feed requirements on a daily basis.

Inadequate intake of amino acids, major minerals, vitamins, or water also can limit sow productivity. As litter size and milk production increase, the requirements for many nutrients also increase. At the same time, industry consolidation, which demands improvements in cost competitiveness, coupled with environmental stewardship results in lowering of margins of safety for many nutrients. Thus, we need further work to continue to refine the requirements of nutrients, such as phosphorus and major amino acids. Many other ingredients that are not added to all sow diets have literature supporting their impact on sow productivity, including chromium, carnitine, organic selenium, and omega 3 fatty acids to name a few. Further research is needed to help determine when use of these ingredients is warranted and when they are not required in the diet.

Tokach, Mike D. Animal Sciences and Industry, 246 Weber Hall, Kansas State University, Manhattan, KS 66506, Tel (785) 532-2032, email: mtokach@ksu.edu

Paul Yeske
Swine Veterinary Center
1608 S. Minnesota Ave.
St. Peter, MN 56082
PH:
EM: pyeske@swinevetcenter.com