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Research Proposal Summary: Effects of Nutrition During Gilt Development on Sow Lifetime Productivity of Two Prolific Maternal Lines

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Summary and Implications

A four-parity study is proposed to examine the effects of nutritional manipulation during gilt development on subsequent sow performance. Gilts will be selected from two genetic lines that are highly prolific, but differ in rate and composition of growth. During the development period (45 to 250 lb), gilts will be provided either; i) ad libitum access to feed, or ii) ad libitum access to feed until 120 days of age (180 lb) and 75% of ad libitum feed intake thereafter (until first post-pubertal estrus). Sow and litter performance criteria will be examined. In addition, the economics of sow productivity and longevity will be evaluated using a return on equity model. Crossbred females of the Nebraska Index Line (NIL) with other maternal lines are being used in several herds within Nebraska and the United States. Not only has there been little research conducted investigating the effects of nutritional manipulation during gilt development on future sow productivity of the NIL crosses, but little information is available regarding how gilt development (as affected by nutritional manipulation) influences sow productivity of early-maturing, prolific sows. Results from this research project will help producers make decisions regarding the management of replacement gilts and define management scenarios that will optimize sow lifetime productivity. Project progress and research data updates will be provided annually in the University of Nebraska Swine Report until the completion of the study.

Introduction

Ten to 20 years ago, annual sow death losses of 4 to 5% and annual sow replacement rates of 35 to 45% were typical in commercial swine herds. Today, much of the industry is experiencing average annual sow death losses of 10 to 12%, and death losses as high as 18% in some herds have been reported. As a result of increased sow death losses and other causes of involuntary culling, annual sow replacement rates of 45 to 55% are commonplace, and rates of 60% have occurred in some herds.

Causes of increased sow losses are not well documented, but sow housing systems and management practices have not changed greatly during this period. Gilts are developed to grow as rapidly as possible, mated at their second or third post-pubertal estrus, and mated again for the next litter within five to 10 days of weaning a litter (after a 15- to 21-day lactation period). It is commonly believed that the increased annual sow replacement rates are related to one or more of the following: genetic selection for prolificacy or selection for increased leanness and faster growth rate that has occurred in developing modern maternal lines.

In addition, it is generally accepted that gilts will be provided ad libitum access to feed until 230-250 lb; thereafter, gilts are limit fed until flushing/breeding at approximately 300 lb. This system of gilt management may not be appropriate for all maternal lines. Specifically, gilts of prolific, early-maturing lines may be able to enter the sow herd at body weights < 300 lb without compromising lifetime productivity and(or) health status. Therefore, protocols should consider controlling (limiting) feed intake prior to 230-250 lb.

In this project, we propose to determine whether alternative gilt nutritional development strategies affect longevity and lifetime productivity of prolific lines of pigs. Gilts of two lines will be fed two different dietary regimens during the gilt development period in a 2×2 factorial arrangement of treatments and evaluated for reproduction traits through four parities. Two highly prolific genetic lines that differ in rate and composition of growth will be used. The two genetic groups will be produced by mating commercial Large White-Landrace cross females, used regularly in the University of Nebraska (UNL) nutrition research program, with semen of boars of another commercial maternal line or with Nebraska Index Line (NIL) boars.

Development of the Nebraska

Table 1. Average expected performance for P1 and P2 gilts based on NPPC Maternal Line Evaluation Project[a].

Trait	P1	P2
ADG, 10 lb to 150 d of age, lb/d	1.35	1.20
10^{th} rib BF at 212 lb, in	0.63	0.71
Loin depth at 212 lb, in	2.42	2.25
Age at first estrus, d	222	209
Gilt farrowing rate, %	76	92
Total born/litter, avg of 4 parities	11.3	12.0
Wean to service interval, d	11.0	9.6
Percentage of gilts with 4 litters	49.0	69.9

[a]P1: A cross of boars of commercial line (L_M) with UNL Large White-Landrace gilts. **P2**: A cross of L_M with Nebraska Index Line gilts.

Index Line. The University of Nebraska has a long history of research in genetics and physiology of reproduction. Early work determined that ovulation rate is 35-40% heritable and responds to selection, but because of limitations in embryonic survival and uterine capacity, only about 25% of the increase in ovulation rate is realized in increased litter size. The limitation was overcome by selecting for an index of ovulation rate, embryonic survival, uterine capacity and litter size. During 21 generations of selection, the NIL that averages 13.5 to 14 pigs per litter, 45% greater than the control, was developed. Crossbred gilts of NIL with Monsanto Choice Genetics Line 34 (GPK34) were entered into the NPPC Maternal Line Evaluation Project (MLE) along with gilts of five other commercial organizations. The NIL × GPK34 (a gilt expected to be similar to the one to be developed for this study) had 30 to 50% greater production through four parities than the other females. As a result, the NIL was released to the industry and is being used in several breeding programs. It currently is recognized as one of the most prolific females available to swine breeders. Therefore, the objective of this proposal is to determine whether alternative gilt development strategies affect longevity and lifetime production of two prolific maternal lines.

Procedures

Description of gilts to be evaluated:

Gilt Population I **(P1)**: A cross of boars of commercial maternal line (L_M) with UNL Large White-Landrace gilts

Gilt Population II **(P2)**: A cross of L_M with NIL gilts

The UNL Large White and Landrace lines and the commercial line L_M are industry lines selected for increased prolificacy, growth rate, and leanness. The NIL is a line produced within the UNL genetics research program that has been selected 21 generations for increased prolificacy with very little selection for increased growth and improved leanness. P1 and P2 gilts are expected to have reproductive, growth, and lean similar to that of certain crosses that were evaluated in the NPPC MLE (Table 1).

Pigs will be housed and procedures will be conducted, at the UNL Swine Unit, Ithaca, Neb. All procedures and treatments will be in accordance with UNL Institutional Animal Care and Use Committee guidelines. Breedings to produce the aforementioned lines will initiate in early September, 2004. Accordingly, females (50 litters available per treatment; 25 litters/line) will be born in January, 2005 (Replicate 1). The breeding regimen used to develop Replicate 1 will be repeated beginning January, 2005 to create Replicate 2. Therefore, 200 gilts (50 gilts per population × dietary treatment) will be used. Females will be selected for the experiment at or prior to weaning (17 to 21 days postfarrowing). Two females per litter will be identified and randomly selected for future allotment to one of the dietary regimens (see below). After weaning, all gilts will be group-housed in a modified-open-front building (approx. 8 to 10 pigs/pen). Gilts will have ad libitum access to a standard three-phase grower diet system (Phase 1, 1.15% lysine; Phase 2, 1.00% lysine; Phase 3, 0.90% lysine; 45 to 80 lb, 80 to 130 lb, and 130 to 180 lb, respectively). Diets will be corn-soybean meal-based with .15% crystalline lysine included.

At approximately 120 days (180 lb), half (n = 25/line) of the gilts will continue to be given ad libitum access of a 0.70 % lysine diet (0.70% Ca, 0.60% P; **TRT 1**) until breeding. The remaining 25 gilts/line will be limit fed (75% of ad libitum intake) a diet containing 0.93% lysine (1.0% Ca, .80% P; **TRT 2**) until breeding. At 140 days of age, gilts will be heat checked twice daily using an intact boar. Pubertal estrus will be recorded and matings will begin at the first post-pubertal estrus. From day 0 to breeding, growth performance criteria and real-time ultrasound measurements (back fat (BF) thickness and longissimus muscle area (LMA)) will be recorded every two weeks. Gestation and lactation management will be identical for all sows. Sows will receive approximately 4 lb of a 0.55% lysine diet during gestation and have ad libitum access to lactation diets (1.0% lysine). Body weight, BF and LMA will be recorded at each farrowing and weaning. Any cross fostering to equalize litter size will be conducted within three days

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postfarrowing. The following sow performance criteria will be collected: litter size (total and live), number and weight of pigs at weaning, and return to estrus (relative to weaning date). Pigs will be weaned at 17 to 21 days post weaning. Daily heat checking will be initiated three days postweaning until expression of estrus. Sows will be bred at the first or second estrus postweaning. Sows that are not bred by day 21 postweaning will be culled. Sows will remain on treatment for a maximum of four consecutive parities. Criteria for gilts to be allocated to treatment and sow culling procedures to be used are described in the Maternal Line National Genetic Evaluation Program Results (NPPC; April, 2000). The economics of sow productivity and longevity will be evaluated using the NPPC Return on Equity (ROE) Model.

Anticipated Results

Based on the MLE, when gilts were developed with the common industry practices, expected differences between P1 and P2 gilts are described in Table 1. We hypothesize that feed restriction (prior to 250 lb) will not adversely affect productivity or health status of the P2 gilt line; however, reduced energy intake during late development will reduce lifetime productivity of the P1 line.

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