Sow and Litter Performance for Individual Crate and Group Hoop Barn Gestation Housing Systems: Project Summary

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Summary and Implications

Effects of gestation housing systems on sow and litter performance were evaluated for 2.5 yr at the ISU Lauren Christian Swine Research Farm, Atlantic, Iowa. Gestation housing system treatments were 1) individual gestation stalls in a mechanically ventilated confinement building with a partially slatted floor and a manure flush system; and 2) group pens with individual feed stalls in deep-bedded, naturally ventilated hoop barns. The confinement facility was more than 15 yr old and had been updated in the late 1990s. The two gestation hoop barns were built at the same time as the confinement facility was remodeled.

This is a final project summary. In all, 957 litters from 353 sows were analyzed using mixed models. The number of pigs born alive per litter differed for the two housing treatments ($P = 0.002$), with gestation in hoop barns resulting in more pigs born alive per litter. Prewean mortality was not different for the two housing treatments ($P = 0.70$). Cross-fostering was done to equalize litter size within 24 h of birth, which resulted in an equal number of weaned pigs per sow ($P = 0.50$) regardless of gestation housing treatment. Wean-to-breed interval was different ($P = 0.01$) with sows kept in stalls returning to estrus sooner (4.3 ± 0.6 d) than sows gestated in hoop barns (6.0 ± 0.6 d). Results indicate that gestating sows can be housed as groups in deep-bedded hoop barns equipped with individual feeding stalls and that their performance is comparable to gestating sows housed in systems with individual gestation stalls.

Materials and Methods

The study was conducted at the ISU Lauren Christian Swine Research Farm, Atlantic, Iowa, for 2.5 years (2001 to 2003). The two hoop barns (32.9 × 9.1 m) were oriented north to south with a 4.5-m-wide raised concrete pad spanning the length of the western wall of each building. Standard (2.1 × 0.51 m or 6.9 × 1.7 ft) feeding stalls were set on the concrete pad, and an access alley ran the length of the building in front of the stalls. The feeding stalls were equipped with rear gates that were closed at the time of feeding to limit feeding aggression and variations in feed intake. The feed stalls also opened at the front, allowing the transfer of individual animals from the hoop barn to the

farrowing facility. The concrete pad was 0.76 m (2.5 ft) above the finished grade of the bedded area, allowing the stalls to remain bedding free. During summer, a sprinkler system was used to periodically wet the concrete pad. A frost-free waterer was placed on a raised platform along the eastern wall of the hoop barns. Semi-permanent fencing was set east to west at the midpoint of the barn; subdividing each 32.9 m (108 ft) hoop barn into two pens housing 32 sows each. There was an individual feeding stall for each sow in a given pen and sows were allowed to use this area for lounging as well. Within each hoop barn, there was 3.44 m^2/sow (27 ft^2), with 1.08 m^2 (11.6 ft^2) being occupied by the individual feeding stall and the remaining 2.36 m^2 (25.4 ft^2) found in the bedded area.

The confinement facility was a mechanically ventilated building that had been updated in the late 1990s to house 120 gestating sows. Four rows of individual stalls (2.1 × 0.6 m or 6.9 × 2 ft) ran the length of the building. Each stall had an individual nipple waterer and was equipped with a dripper for cooling the sow during summer. Feed was delivered to individual stall troughs via an automated auger system. The front two-thirds of each stall was solid concrete flooring while the rear third was slatted. Urine and feces dropped to a shallow pit below the sows and were periodically flushed to a larger holding basin outside of the building.

The sow genotype was ¼ Hampshire × ½ Yorkshire × ¼ Landrace. Multiparous sows were randomly assigned to a gestation housing system treatment when the project commenced. All first-parity gilts were gestated in individual stalls and randomly assigned to a gestation cohort after breeding for the second parity. This practice was followed to minimize size differential and aggression between the sows within the group housing system.

Farrowing occurred every 2 wk throughout the year in 1 of 4 farrowing rooms on the farm. Farrowing rooms were in a mechanically ventilated building with raised crates and a manure flush system. Sows were moved as a group to farrowing rooms within 4 d of expected parturition. Sows were washed and disinfected before entry into the farrowing crates. Sows were also weighed and tenth rib backfat was determined at the P2 location using a Renco Lean-Meter™. Sow vaccinations were for parvovirus/leptospirosis/erysipelas, *E. coli,* and clostridial scours. Sows were dewormed twice per year with ivermectin in the feed.

At farrowing, the number of pigs born alive, stillborn pigs, and mummified pigs were recorded. Litter birth weight of the live pigs was also recorded. Cross-fostering within 24

hr of birth was permitted to equalize litter size within a farrowing room. Cross fostering across gestation housing treatments was allowed. Weaning occurred at 17 to 21 d of age. At weaning, the litter was counted and weighed prior to being moved to a hot nursery facility. Sows were also weighed and their tenth rib backfat at the P2 location was measured. Changes in weight and backfat depth between entrance into the farrowing crate and weaning were then calculated.

Following weaning, sows were moved into a central confinement breeding barn with a slatted floor. Beginning 4 d post-weaning, heat detection with a mature boar was performed daily. Sows were artificially inseminated 24 h after estrus detection. A second insemination occurred 48 h after estrus detection. Insemination was accomplished in the presence of a mature boar. All sows in the study were inseminated with terminal Duroc semen from a commercial boar stud. Semen was delivered to the farm within 24 h of collection 2 to 3 times weekly. After mating, females were allocated to one of the two gestation systems based on production schedule. If possible sows that had been previously gestated in hoop barns were returned to hoop barns and sows that had previously been gestated in individual stalls returned to individual stalls. Sows were moved as a group to their assigned gestation housing treatment by 9 d postweaning.

In order to match production conditions, equal size groups were gestated in the hoop barns. Each hoop barn had two pens housing 32 sows each, thus groups of 32 sows were placed in a particular pen within one of the two hoop barns by 9 d postweaning. Sows that had been gestated in hoop barns previously were heat checked 4 d after weaning, and those that displayed estrus were inseminated and returned to group pens in hoop barns. Other sows that had been weaned and mated at the same time were added as needed to maintain group size when the sows were moved from the breeding barn to gestation housing. To conserve resources and match typical production practices that keep facilities as full as possible, sows that conceived from 9 d past weaning to 70 d post-weaning were reincorporated into a later group. Sows were allowed to transfer from one gestation housing treatment to the other following breeding, but not mid-gestation. Once a group of 32 sows had been established within a pen inside a hoop barn, no replacement sows were added until the group had farrowed.

During gestation, every sow received 2.04 kg/d (4.5 lb/d) of a corn-soybean meal diet that met the daily nutritional requirements. During the last trimester of gestation, feed allowance was increased to 2.72 kg/d (6 lb/d). Baseline feeding was increased seasonally (November through March) by 25% for sows housed in hoop barns and by 5% for sows housed in individual stalls. During lactation, sows received ad libitum access to a corn-soybean diet formulated for lactation.

Sows remained in the study until culling. Culling was done because of poor performance, failure to conceive

within 70 d of weaning, lack of fitness (poor body condition and/or lameness), or death. Sows were not culled due to age or parity.

Reproductive performance was summarized and analyzed for 957 litters using the MIXED procedure of SAS (SAS Inst. Inc., Cary, NC). Data analysis showed that for litter-specific traits (e.g., number born alive, number weaned) the performance of sows that remained on one gestation housing treatment for their entire productive lifetime did not differ from the performance of sows that changed housing treatments. Thus, all litter-specific data was analyzed considering each litter as the unit of analysis. The experimental unit was the individual sow because the housing treatment was imposed on a particular sow at a particular parity.

Sow reproductive traits included number born alive, stillborn, total pigs born, mummified pigs, pigs weaned, pigs nursed, litter weight at birth, litter weight at weaning, and wean-to-breed interval. Recorded traits were also used to calculate important indicators of productivity such as prewean mortality and litter weight gain. Characteristics of sows recorded before and following lactation included breeding season (summer: April to September or winter: October to March), length of previous lactation, and lactation length.

Results and Discussion

Reproductive performance data were recorded for 957 litters from 353 sows, and LS means are summarized by housing treatment in Table 1. Sows housed in hoop barns during gestation gave birth to more ($P = 0.002$) live pigs per litter (10.0±0.2 pigs) than sows gestated in confinement stalls (9.3±0.2 pigs). There was a trend for sows kept in individual stalls to give birth to more stillborn pigs ($P = 0.06$), and sows gestated in hoops tended to give birth to more total pigs ($P = 0.05$). There were no differences ($P = 0.30$) in the number of mummified fetuses for the two housing treatments. Despite more pigs born alive, litters from sows gestated in groups were no heavier ($P = 0.40$) at birth or weaning than litters from sows gestated in individual stalls. After cross-fostering, there was no difference ($P = 0.70$) in size of litter nursed between the two gestation housing systems. Prewean mortality was not different ($P = 0.70$) based upon gestation housing. Due to cross-fostering across treatments to equalize litter size, number of pigs weaned per litter did not differ ($P = 0.50$) for the two gestation housing treatments. After weaning, sows that had been housed as individuals prior to farrowing successfully mated sooner ($P = 0.01$) than sows gestated in hoop barns. Parity affected all reproductive measures except total number of pigs born. There was no gestation housing treatment by parity interaction ($P \geq 0.1$) for any performance trait examined.

Least square means for gestation housing treatment by breeding season interactions are detailed in Table 2. After Tukey-Kramer correction for multiple testing, interactions

remained between gestation housing and breeding season. Sows bred during winter (October to March) and gestated in hoop barns produced 10.3 live pigs/litter, which was more than the number of pigs born alive to sows bred during summer (April to September) for either housing treatment ($P < 0.05$). Sows bred during the winter and gestated in individual stalls gave birth to fewer ($P < 0.005$) live pigs (9.1 ± 0.2) than winter-bred sows gestated in group pens in hoop barns (10.3 ± 0.3). While the number born alive increased from the summer to winter breeding season for sows gestated in hoop barns, there was a trend for number born alive to decrease from the summer to winter breeding season for sows housed in confinement stalls. An identical pattern was present for stillborn pigs. Sows that were bred during the winter and then gestated in hoop barns gave birth to fewer ($P < 0.05$) stillborn pigs than summer-bred sows housed in either housing treatment and fewer stillborn pigs ($P < 0.005$) than the winter-bred sows gestated in confinement stalls.

Sows gestated in hoop barns gave birth to more live pigs and had equal prewean mortality rates as sows gestated in individual confinement stalls. Number of pigs weaned was not different for the two gestation systems due to cross-fostering across gestation treatments. It appears that sows kept in individual gestation stalls were less able to confront seasonal thermal stresses. The different effects of breeding season on number of pigs born alive and stillborn pigs for the two gestation housing treatments may in part be explained by the enhanced ability of sows gestated in hoop barns to modify their thermal environment. As group sow housing systems continue to evolve and management techniques are further refined, sow performance may improve. Despite being a relatively novel management strategy in the United States, results of this study show that gestating sows can be kept in deep-bedded hoop barns equipped with individual feed stalls with sow performance comparable to gestating sows housed in individual gestation stalls.

Table 1. Effects of gestation housing and parity on reproductive performance of sows

Performance measure	Stall[1]	Hoop[1]	SEM	P-value Trt	P-value Parity
Litters	552	405	--	--	--
Average parity	4.4	4.6	0.1	0.332	--
Total born, pig	11.3	11.7	0.2	0.053	0.089
Mummified fetus, pig	0.21	0.25	0.04	0.277	0.759
Litter wt. at birth, kg	16.2	16.3	0.2	0.442	<0.0001
Litter size after cross-foster, pig	10.5	10.4	0.1	0.654	0.527
Lactation length, d	18.8	18.8	0.5	0.979	0.0005
Pre-wean mortality, %	14.0	15.0	1.0	0.719	0.001
Number weaned, pig	8.9	8.8	0.1	0.483	0.001
Litter wt. at weaning, kg	56.5	57.1	0.6	0.398	<0.0001
Litter wt. gain, kg	40.4	40.3	0.9	0.928	<0.0001
Wean-to-breed, d	4.3	6.0	0.6	0.01	0.002

[1] Stall = individual gestation stalls in confinement barn;
 Hoop = group pens in hoop barns with individual feeding stalls

Table 2. Gestation housing × breeding season effects on reproductive performance[1]

Performance measure	Stall[2]			Hoop[2]		
	Summer[3]	Winter[3]	SE	Summer[3]	Winter[3]	SE
Litters	316	236	--	196	209	--
Number born alive, pig	9.5[ad]	9.1[bd]	0.2	9.7[ad]	10.3[ce]	0.3
Stillborn pig	1.9[ad]	2.1[bd]	0.1	1.8[ad]	1.6[ce]	0.2

[1] Reproductive performance traits with significant gestation housing × breeding season
  interaction only

[2] Stall = individual gestation stalls in confinement barn;
  Hoop = group pens in hoop barns with individual feeding stalls

[3] Summer = April to September; Winter = October to March

[abc] Within a row, LS means lacking a common superscript letter differ
  (Tukey-Kramer adjusted P < 0.05)

[de] Within a row, LS means lacking a common superscript letter differ
  (Tukey-Kramer adjusted P < 0.005)