Effects of a Pre-weaning Socialization System on Piglet Mortality and Growth Performance, and Subsequent Sow Performance

Larissa L. Becker, Paula Giacomini, Jordan T. Gebhardt,[1] *Mike D. Tokach, Robert D. Goodband, Joel M. DeRouchey, Jason C. Woodworth, and Annie B. Lerner*[2]

Summary

A total of 3,307 (PIC L 42) mixed-parity sows and 55,160 (PIC 337 × L 42) piglets were used to determine the effects of different farrowing systems on piglet livability, lifetime growth performance, and subsequent sow performance. Treatments were assigned to farrowing rooms and consisted of a conventional farrowing system (sows and piglets housed in individual farrowing crates) or a pre-weaning socialization system (crate dividers removed between farrowing crates and walkways within 6 to 24 hours post-farrowing such that 12 to 32 litters of piglets were co-mingled). A total of 40 farrowing rooms with 80 crates each were used with 20 replications per treatment. Pigs were weaned at approximately 23 d of age. No differences were observed in lactation length, total born, born alive, stillborn, mummies, or the number of pigs weaned. Pre-wean mortality was greater ($P < 0.001$) for pigs from the pre-weaning socialization system compared to pigs from the conventional system (14.7 vs 12.6%, respectively). A greater ($P \leq 0.015$) percentage of pigs died in the pre-weaning socialization system compared to pigs from the conventional system due to being laid on, starving out, *Streptococcus suis*, and either umbilical or scrotal ruptures. However, a greater ($P = 0.014$) percentage of pigs died from scours in the conventional system compared to the pre-weaning socialization system. No differences were found in subsequent sow performance, except a marginally significant ($P \leq 0.082$) increase in the percentage of sows bred by d 4 and 7 for sows previously housed in the pre-weaning socialization system. A subset of offspring (4,313 pigs initially 11.9 ± 0.34 lb) were transported to a commercial research facility to evaluate lifetime performance. Weaning weights were heavier ($P < 0.001$) for the conventional system compared to the pre-weaning socialization system. Pigs were housed in pens according to sow treatment (conventional or pre-weaning socialization) with 44 to 46 pigs per pen and 48 replications per treatment. During the nursery and grow-finish periods, pigs from the conventional system had increased ($P < 0.001$) BW, ADG, ADFI, but poorer F/G compared to pigs from the pre-weaning socialization system. In the nursery phase, removals, mortality, and total removals and mortality

[1] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.
[2] Schwartz Farms, Sleepy Eye, MN.

were greater ($P \leq 0.059$) in pigs raised in the pre-weaning socialization system than in the conventional system, but no differences were observed in the growing-finishing phase. For the overall period (d 23 to 183), pigs from the conventional system had increased ($P \leq 0.001$) BW, ADG, and ADFI, but poorer F/G compared to pigs from the pre-weaning socialization system. No differences were observed for removals and mortality. For overall carcass data, pigs from the conventional system had increased ($P \leq 0.094$) HCW, carcass yield, loin depth, and lean percentage compared to pigs from the pre-weaning socialization system. In summary, pigs raised in the conventional farrowing system had increased livability, lifetime growth performance, and carcass characteristics compared to pigs raised in the pre-weaning socialization system.

Introduction

Pre-weaning socialization systems during the lactation period have been a recent topic of interest to help with the abrupt transition piglets face during weaning. A pre-weaning socialization system can be described as an environment where piglets have the opportunity to nurse from more than one sow through the removal of dividers between farrowing crates. Piglets are allowed to have their choice of sow to nurse and are exposed to larger social environments. Naturally, pigs are social animals and prefer to live in small groups. However, a social hierarchy is developed when pigs are first mixed. The use of a pre-weaning socialization system is hypothesized to reduce the aggressive behavior that occurs at weaning because piglets would be exposed to a social environment shortly after birth.

We hypothesized that the pre-weaning socialization system would reduce pre-weaning mortality and increase weaning weights compared to the conventional system. The objective of this experiment was to determine the effects of a pre-weaning socialization system during the lactation period on piglet growth and livability, pig growth performance from birth to market, and subsequent sow performance.

Materials and Methods

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at Schwartz Farms in Herington, KS. Sows were housed in individual farrowing crates that measured 6 ft × 7 ft 6 in including sow and litter area and were equipped with a dry self-feeder and a bowl waterer.

Animals and diets

Lactation

A total of 3,307 (PIC L 42) mixed parity sows were used. On approximately d 112 of gestation, sows were moved from gestation to farrowing rooms. Treatment was assigned to an entire farrowing room in consecutive order such that each treatment was assigned to every other room. A total of 40 farrowing rooms were used with 20 replications per treatment. Farrowing rooms consisted of 80 crates with five rows of 16 crates. The farrowing rooms were managed as all-in, all-out. Sows were allowed ad libitum access to feed after parturition. Sows remained on their assigned management treatment until weaning.

All sows were fed a common diet and assigned to a management treatment of a conventional farrowing system (sows and piglets housed in individual farrowing crates) or a pre-weaning socialization system (crate dividers removed between farrowing crates and walkway within 6 to 24 h post-farrowing such that 12 to 32 litters of piglets were co-mingled; Figure 1). Thus, farrowing rooms were considered experimental units. Sub-populations were created within the pre-weaning socialization system and categorized as general, small, or critical populations (Figure 2). Visibly small pigs were identified at birth and allowed to co-mingle in a designated area of approximately four to six farrowing crates, depending on the number of small pigs born in each farrowing room. The critical population consisted of pigs that were very small at birth and needed intensive care. The designated area for this population was two farrowing crates that remained closed and did not allow pigs to co-mingle throughout the whole lactation period. All piglets had their needle teeth clipped and were given an antibiotic (Excede) within 24 h after birth. Approximately 3 d after birth, all piglets received an iron supplement, tails were docked, and males were castrated.

Creep feed was offered to all piglets at approximately 18 d of age. For pigs raised in the conventional system, creep feed was provided on a mat in the farrowing crate. For pigs raised in the pre-weaning socialization system, creep feed was provided in rotary feeders with a hopper. Feeders were monitored daily and new feed was added as needed. Creep feed was provided once daily to pigs raised in the conventional system.

Within the conventional farrowing system, litter size was standardized through cross-fostering of pigs within 24 h of parturition. The number of pigs born alive, stillborn, and mummified were recorded for each sow. Total pigs born per litter was calculated as the sum of pigs born alive, stillborn, and mummified. All data were managed on a farrowing-room basis by adding the responses for all sows in a farrowing room.

All instances and reasons for piglet mortalities were recorded. Total pre-weaning mortality was calculated as: (number of pigs weaned – number of pigs born alive). Percentage pre-wean mortality was calculated as: (number of pre-weaning mortalities / number of pigs born alive).

On the day of weaning, sows were moved to gestation stalls and checked daily for signs of estrus. Wean to first service interval and the percentage of sows bred by d 4, 7, and 34 were recorded for the sows that remained in the herd after culling. Farrowing rate and subsequent liveborn were also evaluated. During this subsequent performance period, all sows consumed a common gestation and lactation diet and farrowed in a conventional farrowing system.

Nursery

Pigs were weaned at approximately 23 d of age. A subset of the offspring (4,313 pigs; PIC 337 × L 42; initially 11.9 ± 0.34 lb) from four farrowing rooms (two rooms per treatment) were transported to a commercial wean-finish research facility (Sleepy Eye, MN). Pigs were tagged with an RFID ear tag (LeeO, Merck Animal Health, Rahway, NJ) prior to weaning to identify the offspring from sow treatments by using two different colored ear tags. During the nursery period (d 23 to 64 of age), pigs were housed in pens according to sow treatment (conventional or pre-weaning socialization) with 44 to 46 pigs per pen and 48 replications per treatment across two rooms. The nursery was "double-stocked" with approximately 4 sq ft per pig. The barn was filtered with totally slatted floors. Each pen was equipped with a 3-hole stainless steel self-feeder and a bowl waterer for ad libitum access to feed and water. Daily feed additions to each pen were made and recorded by an electronic feeding system (DryExact Pro; Big Dutchman North America, Holland, MI).

Cortisol concentrations in serum were used as an indicator to determine if farrowing system influenced the stress response of pigs post-weaning. Upon arrival at the wean-finish facility, pigs were randomly placed into holding pens and allowed to acclimate for 2 h. Then, 96 gilts per treatment (192 gilts total) were randomly selected for blood sample collection. Approximately 10 mL of blood was collected from the jugular vein using a red-top, no anti-coagulant blood tube. The blood was centrifuged (3000 × g, 30 min) within 2 h after collection, and serum was stored at −4°F (−20°C) until analysis. Serum was analyzed for cortisol concentrations using a commercial ELISA kit (Cortisol Parameter Assay Kit, R&D Systems, Minneapolis, MN).

Pens of pigs were weighed periodically throughout the nursery period to calculate ADG, ADFI, and F/G. Feed disappearance was measured by using a volumetric regression equation, which estimated the quantity of feed remaining in the feeder subtracted from the quantity of feed added to the feeder.

Pigs that died or were removed during this study due to sickness or injury were recorded. Any pig that was removed from a test pen was considered a removal and placed into an off-test pen where they remained for the duration of the study. Mortality is defined as a pig that died while in a test pen.

At the end of the nursery period, one half of the pigs were moved to a different finishing facility, (not on test) while the other half were again divided (barrows vs gilts) to provide approximately 8 sq ft per pig. There were 18 to 24 pigs per pen and 48 pens per treatment. Data from the two pens (one barrow pen and one gilt pen) were combined for grow-finish and wean-finish analysis (24 observations per finishing treatment).

Grow-finish

A total of 2,073 pigs (initially 95.9 ± 4.82 lb) were used with 18 to 24 pigs per pen and 24 replications per treatment during the grow-finish period (d 64 to 183 of age). Pens of pigs were weighed periodically to calculate ADG, ADFI, and F/G. At the conclusion of the experiment, any pigs that were too light and did not reach market weight were counted, weighed, and transported to a holding site to grow until approximate target market weight.

Prior to marketing, all pigs were tattooed with a pen identification number to provide additional identification to the RFID ear tags received at weaning. During the first marketing event, the six heaviest pigs in each pen were selected and transported to a U. S. Department of Agriculture-inspected packing plant (JBS Swift, Worthington, MN) for carcass data collection. The first marketing event occurred on d 154 for barrows and d 165 for gilts. The remaining pigs within pens were marketed to the same packing plant on d 171 for barrows and d 183 for gilts. Carcass measurements were recorded using the using an RFID scanner (LeeO, Merck Animal Health, Rahway, NJ). Data collected included HCW, carcass yield, backfat, loin depth, and percentage lean.

Carcass yield was calculated by dividing the pen average HCW by the pen average live weight obtained at the farm. Percentage lean was calculated from a plant proprietary equation.

Statistical analysis

Experimental data were analyzed using the GLIMMIX procedure of SAS (SAS Institute Inc., Cary, NC) with farrowing room serving as the experimental unit for the pre-weaning portion of the study. Individual piglets served as the observational unit for pre-wean mortality data. Treatment was used as the fixed effect. For the wean-to-finish period, pen served as the experimental unit, and wean group was used as a random intercept. Mortality data were analyzed using the GLIMMIX procedure and specified a binomial distribution. For the percentage of sows that were bred back, data were analyzed using a binomial distribution. The count of sows bred back by the respective date was compared to the number of sows eligible to be bred back following weaning. Results were considered significant with $P \leq 0.05$ and were considered marginally significant with $P \leq 0.10$.

Results and Discussion

Sow performance

For sow and litter performance, no differences were observed in lactation length, total born, born alive, stillborn, mummies, or the number of pigs weaned (Table 1).

Pre-weaning mortality percentage was greater ($P < 0.001$) for pigs from the pre-weaning socialization farrowing system compared to pigs from the conventional system. A greater ($P \leq 0.015$) percentage of pigs died in the pre-weaning socialization system compared to pigs from the conventional system due to being laid on, starving out, *Streptococcus suis*, and either umbilical or scrotal ruptures. However, a greater ($P = 0.014$) percentage of pigs died from scours in the conventional system compared to the pre-weaning socialization system. No differences were observed for the percentage of pigs dying from unknown reasons, low viability, deformity, or greasy pig disease.

For subsequent sow performance, no differences were observed in wean-service interval, percentage of sows bred by d 34 post-farrow, farrowing rate, or number of liveborn piglets in the subsequent farrowing. A marginally significant ($P \leq 0.082$) increase in the percentage of sows bred by d 4 and 7 was observed for sows previously housed in the pre-weaning socialization system.

Wean-to-finish performance

No differences were observed in serum cortisol concentrations between farrowing systems after placement in the wean-finish facility (Table 2). However, visually, the pre-weaning socialization piglets were easier to move during weaning and arrival at the wean-finish facility.

Pigs weaned from the conventional farrowing system had heavier BW ($P < 0.001$) at weaning (23 d of age) compared to pigs from the pre-weaning socialization system.

During the nursery period (d 23 to 64), pigs from the conventional system had increased ($P < 0.001$) BW, ADG, and ADFI, but poorer F/G compared to pigs from the pre-weaning socialization system. Removals, mortality, and total removals and mortality were greater ($P \leq 0.059$) in pigs from the pre-weaning socialization system compared with those from the conventional farrowing system.

During the grow-finish period (d 64 to 183), pigs from the conventional system had increased ($P \leq 0.046$) BW, ADG, and ADFI, but poorer F/G compared to pigs from the pre-weaning socialization system. No differences were observed in total removals and mortality. Additionally, the percentage of lightweight pigs (average BW of 209.2 lb) at the end of the grow-finish period was greater ($P < 0.001$) for pigs farrowed in the pre-weaning socialization system compared to pigs from the conventional system.

For the overall period (d 23 to 183), pigs from the conventional system had increased ($P \leq 0.001$) BW, ADG, and ADFI compared to pigs from the pre-weaning socialization system. However, pigs from the pre-weaning socialization system had improved ($P = 0.010$) F/G compared to pigs from the conventional system. No differences were observed for removals and mortality.

Carcass characteristics

For the first marketing event, pigs from the conventional system had increased ($P \leq 0.016$) HCW, loin depth, and percentage lean compared to pigs from the pre-weaning socialization system (Table 3). No differences were observed for carcass yield or backfat depth.

For the final marketing event, pigs from the conventional system had increased ($P \leq 0.001$) HCW and loin depth compared to pigs from the pre-weaning socialization system. No differences were observed for carcass yield, backfat depth, or percentage lean.

Overall, pigs from the conventional system had increased ($P \leq 0.094$) HCW, carcass yield, loin depth, and percentage lean compared to pigs from the pre-weaning socialization system. No differences were observed for backfat depth.

In summary, pigs raised in the conventional farrowing system had increased livability, lifetime growth performance, and carcass characteristics compared to pigs raised in the pre-weaning socialization system. However, pigs raised in the pre-weaning socialization system were visibly easier to move during weaning, arrival at the wean-finish facility, and during first pen weighing event.

Acknowledgments

Appreciation is expressed to Schwartz Farms for providing the animals and sow research facility, and to Dr. Annie Lerner for technical assistance. Appreciation is also expressed to Hubbard Feeds for use of the wean-to-finish research facility, and to Melissa Pietig and Morgan Hart for technical assistance.

Table 1. Effects of farrowing strategy on sow and litter performance[1]

Item	Conventional[2]	Pre-weaning socialization[3]	SEM	*P* =
Farrowing rooms, n	20	20	---	---
Sow count, n	1,655	1,652	---	---
Sow parity	2.1	2.1	0.18	0.772
Lactation length, d	22.7	22.5	0.22	0.517
Liveborn, n	25,612	25,886	---	---
Litter characteristics, n				
Total born	16.6	16.8	0.30	0.153
Born alive	15.5	15.7	0.32	0.223
Stillborn	0.68	0.69	0.037	0.910
Mummies	0.41	0.44	0.028	0.434
Weaned	13.5	13.4	0.14	0.311
Born alive per room, n	1,281	1,294	21.8	0.273
Pigs weaned per room, n	1,118	1,103	8.2	0.193
Total mortality, n	3,245	3,827	---	---
Pre-weaning mortality, %	12.6	14.7	0.74	< 0.001
Reason, %[4]				
Laid on	4.93	6.13	0.178	< 0.001
Starve out	2.17	2.50	0.387	0.015
Streptococcus suis	0.47	0.85	0.854	< 0.001
Rupture	0.27	0.48	0.088	0.001
Scour	0.28	0.17	0.049	0.014
Unknown	0.82	0.90	0.097	0.310
Low viability, dead	0.86	0.97	0.075	0.182
Low viability, euthanized	2.48	2.39	0.328	0.389
Deformity	0.25	0.25	0.031	0.952
Greasy pig disease	0.01	0.01	0.007	0.651
Subsequent performance				
Wean-service interval, d	9.1	8.4	1.39	0.545
Sows stayed in herd, %	86.5	87.0	1.56	0.680
Bred by d 4, %	49.1	52.7	2.83	0.062
Bred by d 7, %	79.4	82.0	3.85	0.082
Bred by d 34%	98.7	98.9	0.37	0.602
Farrowing rate, %	84.2	85.2	0.99	0.381
Liveborn, n	15.6	15.9	0.14	0.215

[1]A total of 3,307 mixed parity sows and 55,160 piglets were used. Treatments were randomly assigned to farrowing rooms with 80 crates per room. There were 20 replications (rooms) per treatment.
[2]Conventional farrowing strategy with sows and piglets housed in individual farrowing crates.
[3]Pre-weaning socialization strategy defined as crate dividers removed between farrowing crates and walkway within 6 to 24 hours post-farrowing such that 12 to 32 litters of piglets were co-mingled.
[4]Represents percentage of piglets born alive for each mortality reason.

Table 2. Effects of farrowing strategy on wean-finish pig growth performance

Item	Conventional[1]	Pre-weaning socialization[2]	SEM	*P* =
Serum cortisol, ng/mL[3]	57.1	54.4	5.05	0.398
BW, lb				
Weaning, d 23	13.0	10.7	0.34	< 0.001
End of nursery, d 64	56.8	52.8	2.13	< 0.001
End of finisher, d 183[4]	286.1	275.9	5.89	< 0.001
Nursery period (d 23 to 64)[5]				
ADG, lb	1.08	1.03	0.033	< 0.001
ADFI, lb	1.35	1.26	0.049	< 0.001
F/G	1.26	1.22	0.007	< 0.001
Removals, %	1.02	2.13	0.330	0.005
Mortality, %	0.35	0.78	0.281	0.059
Total removals and mortality, %	1.35	2.89	0.570	0.001
Grow-finish period (d 64 to 183)[6]				
ADG, lb	2.09	2.03	0.032	0.001
ADFI, lb	4.90	4.70	0.127	0.001
F/G	2.34	2.32	0.026	0.046
Removals, %	3.40	3.63	0.579	0.776
Mortality, %	2.55	1.91	0.485	0.328
Total removals and mortality, %	5.96	5.55	0.708	0.689
Light weight pigs, %[7]	3.17	7.23	2.595	< 0.001
Avg weight, lb	213.1	209.2	5.80	0.327
Wean to finish (d 23 to 183)[8]				
ADG, lb	1.80	1.74	0.034	0.001
ADFI, lb	3.90	3.73	0.105	0.001
F/G	2.16	2.14	0.018	0.010
Removals, %	4.73	5.93	0.719	0.224
Mortality, %	2.97	2.59	0.517	0.598
Total removals and mortality, %	7.70	8.52	0.849	0.490

[1]Conventional farrowing strategy with sows and piglets housed in individual farrowing crates.
[2]Pre-weaning socialization strategy defined as crate dividers removed between farrowing crates and walkway within 6 to 24 hours post-farrowing such that 12 to 32 litters of piglets were co-mingled.
[3]After a 2-hour acclimation period, 96 gilts per treatment (192 gilts total) were randomly selected for blood sample collection. Approximately 10 mL of blood was collected and analyzed for cortisol concentrations using a commercial ELISA kit (Cortisol Parameter Assay Kit, R&D Systems, Minneapolis, MN).
[4]Represents barn dump weights.
[5]A total of 4,313 pigs (initially 11.9 ± 0.34 lb) were used with 44 to 46 pigs per pen and 48 replications per treatment.
[6]A total of 2,073 pigs (initially 95.9 ± 4.82 lb) were used with 18 to 24 pigs per pen and 24 replications per treatment.
[7]Represents pigs that were too light and did not market with the rest of the pigs. These pigs were transported to a holding site to grow until appropriate market weight.
[8]Represents lifetime performance from weaning to market for 2,073 pigs that remained on site.

Table 3. Effects of farrowing strategy on carcass characteristics[1]

Item	Conventional[2]	Pre-weaning socialization[3]	SEM	*P* =
First marketing event				
HCW, lb	204.7	197.7	5.82	0.001
Yield, %	72.7	72.5	0.22	0.285
Backfat depth, in	0.59	0.59	0.021	0.997
Loin depth, in	2.71	2.59	0.035	< 0.001
Lean, %	58.0	57.6	0.23	0.016
Final marketing event				
HCW, lb	213.2	206.8	4.61	0.001
Yield, %	74.5	74.3	0.28	0.248
Backfat depth, in	0.62	0.62	0.015	0.884
Loin depth, in	2.77	2.69	0.038	0.001
Lean, %	57.7	57.4	0.14	0.102
Overall[4]				
HCW, lb	210.7	204.0	5.11	0.001
Yield, %	74.0	73.7	0.26	0.094
Backfat depth, in	0.61	0.61	0.017	0.995
Loin depth, in	2.76	2.65	0.036	< 0.001
Lean, %	57.8	57.5	0.16	0.018

[1]A total of 2,073 pigs (initially 95.9 ± 4.82 lb) were used with 18 to 24 pigs per pen and 24 replications per treatment. The six heaviest pigs were sold at the first marketing event (d 154 for barrows and d 165 for gilts). The remaining pigs within pens were marketed on d 171 for barrows and d 183 for gilts.
[2]Conventional farrowing strategy with sows and piglets housed in individual farrowing crates.
[3]Pre-weaning socialization strategy defined as crate dividers removed between farrowing crates and walkway within 6 to 24 hours post-farrowing such that 12 to 32 litters of piglets were co-mingled.
[4]Weighted average from all market events.

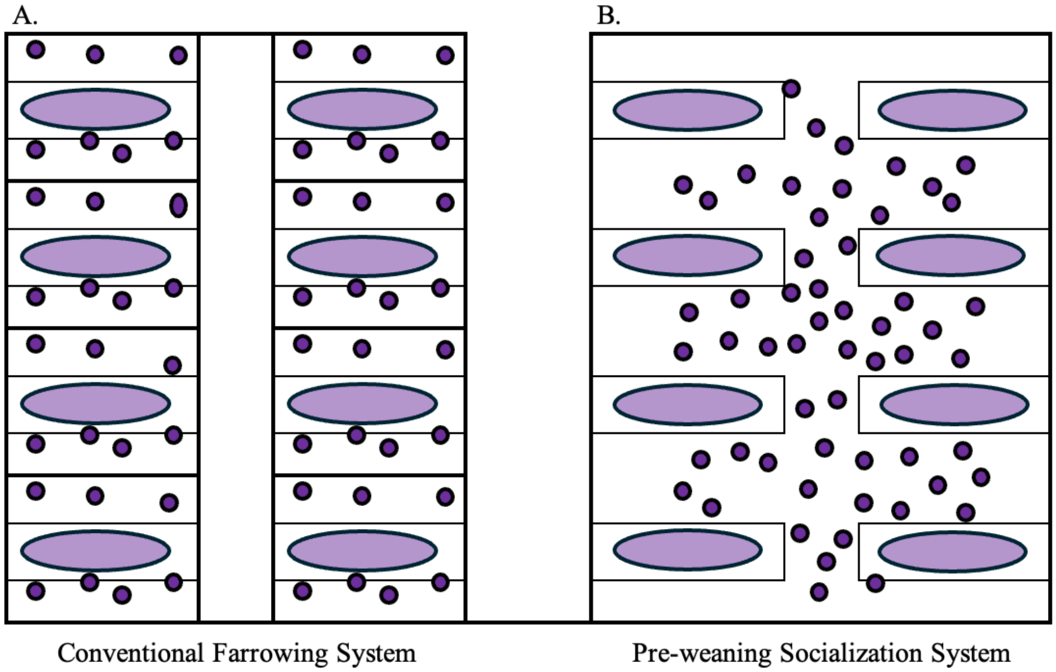

Figure 1. Treatments were assigned on a farrowing room basis. A total of 40 farrowing rooms were used with 20 replications per treatment. Farrowing rooms consisted of 80 crates with five rows of 16 crates each. Each oval represents a sow, and each dark circle represents a piglet. A) Sows and their corresponding piglets were kept separate in individual farrowing crates (thin solid lines represent sow area and thick solid lines represent lay area for piglets within a farrowing crate). B) Sows were housed in individual farrowing crates (thin solid lines) and piglets were able to move between farrowing crates and walkway within 6 to 24 hours after farrowing was completed. Progeny from 12 to 32 farrowing crates were allowed to co-mingle together.

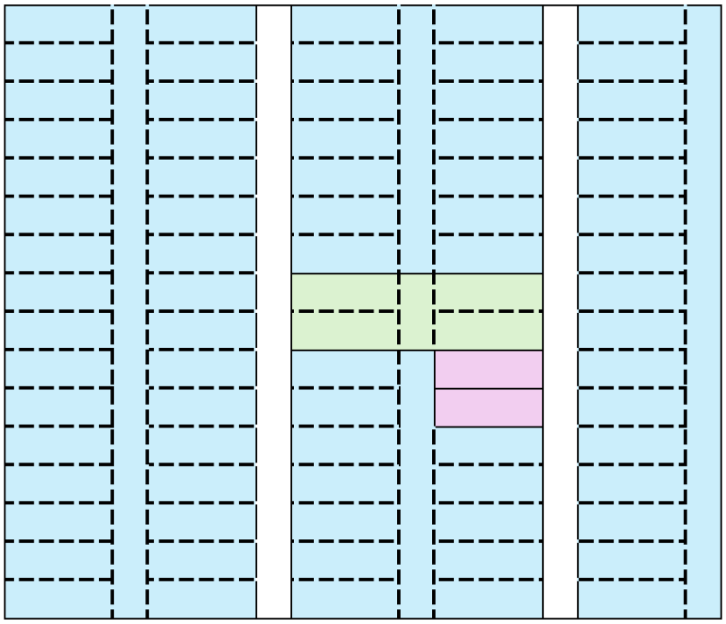

Figure 2. Sub-populations were created within the pre-weaning socialization system and categorized as general, small, or critical populations. Visibly small pigs were identified at birth and allowed to co-mingle in a designated area of approximately four to six crates (green area with dashed lines representing crate dividers that were opened and solid lines representing crate dividers that were kept in to separate populations). The critical population consisted of pigs that were very small at birth and needed intensive care. The designated area for this population was two farrowing crates that remained closed and did not allow pigs to co-mingle throughout the whole lactation period (pink area with solid lines representing closed crates). The general population were allowed to co-mingle together within 12 to 32 farrowing crates (blue area).