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SPACE ALLOCATION AND DIETS

Response of Pigs to Space Allocation and Diets Varying in Nutrient Density[1, 2, 3]

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ABSTRACT: Three experiments were conducted to determine the main and interacting effects on performance of floor space allowance and dietary lysine and energy concentrations for growing-finishing pigs. In each experiment, space allocations of .56 or .78 m^2/pig were achieved with 14 or 10 pigs per pen, respectively. In Exp. 1, diets investigated were NRC (1988) recommended nutrient densities, NRC plus 5% added fat (5F), NRC plus .15% added L-lysine·HCl (L), and NRC plus fat plus lysine (5FL) in a 4 × 2 × 2 factorial arrangement of treatments with space and season (winter [W] vs summer [S]). In Exp. 2 and 3, a 2 × 3 factorial treatment arrangement was used to investigate space and diet effects, with the source of added dietary fat being choice white grease (G) in Exp. 2 and tallow (T) in Exp. 3. Diets investigated contained 0 (CON), 2.5 (2.5 GL/TL), or 5% (5GL/TL) added fat with L-lysine·HCl added to maintain a constant lysine:ME ratio. In Exp. 1, pigs given .56 m^2/pig vs .78 m^2/pig ate less feed (2.28 vs 2.43 kg/d; $P < .001$) and grew slower (.676 vs .710 kg/d; $P < .001$) with no difference in gain:feed or carcass lean percentage. Feed intake was decreased (2.26 vs 2.41 kg/d; $P < .005$) and gain:feed increased (.312 vs .284; $P = .0001$) for the 5FL vs L diet, with the only interaction ($P < .1$) between diet and space being the magnitude of the response to L diets for the .56 vs .78 m^2/pig treatments. In Exp. 2 and 3, there were no interactions ($P > .1$) between diet and space treatments. In Exp. 2, pigs given .56 m^2/pig vs .78 m^2/pig grew slower (.765 vs .795 kg/d; $P = .0005$) with a poorer gain:feed (.301 vs .309; $P < .05$)

and a slower rate of lean gain (.265 vs .271 kg/d; $P < .05$). There was a linear improvement in ADG ($P = .011$) and gain:feed ($P < .05$) with increasing amounts of T in the diet. The lack of space × diet interactions in these experiments suggests that the reduction in ADG associated with the reduction in ADFI for crowded pigs is independent of the dietary lysine and energy concentration.

Key Words: Pigs, Space, Diet

Introduction

When growing-finishing pigs are given less than optimal space per pig, feed intake decreases (Kornegay and Notter, 1984; NCR-89, 1993), often resulting in reduction in ADG, with variable effects on gain:feed. Most of the research on the effects of crowding was conducted using the same dietary nutrient densities for all treatments (Gehlbach et al., 1966; Jensen et al., 1973; Moser et al., 1985; NCR-89, 1993). Thus, it is not possible to determine whether the reduction in daily gain is due solely to crowding or whether some of the decrease in gain is due to a decrease in total nutrient intake associated with the reduced feed intake.

The objective of these experiments was to determine the main and interacting effects on performance of floor space allowance and dietary lysine and energy concentrations for growing-finishing pigs.

Materials and Methods

Facilities. In all experiments, pigs were housed in duplicate, mechanically ventilated, partially slatted, confinement facilities. Each pen measured 1.4 m x 4.9 m. Further facility details have been reported by Brumm et al. (1982) and Shelton and Schulte (1982).

Management. Immediately after arrival, all pigs were weighed, sexed, eartagged, and assigned to experimental treatments on the basis of sex and arrival weight outcome groups.

The experimental diets were limit-fed for 7 d (Exp. 1) or 3 d (Exp. 2 and 3) on the solid floor area of their respective pen according to the recommendation of Brumm et al. (1991). Feed was made available twice daily and was limited to the amount of feed a pen of 10 or 14 pigs would consume in a 3- to 4-h period. After this 7- or 3-d period of restriction, pigs had ad libitum access to the respective diets.

In all experiments, diets were prepared in meal form by a commercial feed mill and delivered in individually identified 22.7-kg net paper bags.

Lean gain containing 5% fat was calculated using the procedures of NPPC (1991) in all experiments.

Exp. 1. A 2 x 2 x 4 factorial arrangement was used to examine possible interactions of season (winter [W] vs summer [S]), space allocation (14 pigs/pen [.56 m^2/pig] vs 10 pigs/pen [.78 m^2/pig]) and diet nutrient density (NRC [1988] recommended nutrient densities, NRC plus 5% added fat [5F], NRC plus .15%

added L-lysine·HCl [L] and NRC plus 5% fat plus .15% L-lysine·HCl [5FL]). The composition of the experimental diets is given in Table 1.

A total of 768 crossbred, commingled, feeder pigs were purchased from auction markets in southern Missouri and transported > 1,000 km to the research facilities.

Each partially slatted building described earlier, housed eight pens, representing a complete replicate of experimental treatments within season. There were two W trials and two S trials (Table 2) for a total of 64 pens of pigs (four pens per treatment combination).

The NRC diets were formulated with corn and soybean meal to provide the NRC (1988) requirement levels of .75% lysine to 50 kg live weight and .60% lysine thereafter. Diets were switched on the week that individual pens of pigs averaged ≥ 50 kg.

All diets contained 55 mg/kg of carbadox for the 1st 4 wk after arrival, or until 34 kg live weight, followed by 110 mg/kg of chlortetracycline to 50 kg body weight and 33 mg/kg of bacitracin methylene disalicylate to slaughter.

Each pen of 10 or 14 pigs was provided with one nipple drinker and one, three-hole self feeder. In the event of pig death or removal, pen sizes were adjusted to maintain the same space allocation per pig, with the ratio of slats to solid portion of the pen remaining constant. Sprinklers or other cooling devices were not used for summer heat relief.

At arrival, each pig received an injection of ivermectin for parasite control. Pigs were retreated for internal parasites at 4 wk postarrival with fenbendazol mixed in the diet. All pigs that died during the experiment were examined for cause of death by a veterinarian.

Humidity was constantly recorded in each facility using a mechanical hydrograph. Temperature minimums and maximums were recorded daily .6 m above floor height in the center of each facility using minimum-maximum thermometers.

Individual pigs were removed for slaughter on the week that they weighed ≥ 109 kg, with no pigs removed until the pen average weight was ≥ 93.2 kg. Pen sizes were not adjusted once removal for slaughter was initiated.

Carcass data were collected on individually identified pigs by employees of the John Morrell Pork Plant in Sioux City, IA using the Fat-O-Meter probe.

Exp. 2 and 3. The 3 x 2 factorial arrangement of treatments used 288 single-source, crossbred feeder pigs transported 450 km in each experiment. In Exp. 2, the dietary fat source was choice white grease (G), whereas tallow (T) was used in Exp. 3.
The experimental treatments to investigate the possible interaction of diet nutrient density and space allocation were:

a) Diet - from arrival to slaughter, diets contained 0 (CON), 2.5 (2.5GL/TL), or 5% (5GL/TL) added fat with L-lysine·HCl added as appropriate to maintain a constant lysine:ME ratio (Table 3).

b) Space - pigs were housed in groups of 10 or 14 per pen, as in Exp. 1.

All diets contained 55 mg/kg of carbadox until 34 kg live weight, followed by 44 mg/kg of tylosin to slaughter. Diets were switched on the week that individual pens averaged 34 kg (carbadox to tylosin), 41 kg (.9% to .8% lysine or equivalent), and 82 kg (.8% to .7% lysine or equivalent).

Each pen of 10 pigs was provided one nipple drinker and two feeder holes whereas each pen of 14 pigs was provided one nipple drinker and three feeder holes. Unlike Exp. 1, pen sizes were not adjusted in the event of pig death or removal.

Sprinklers were used for heat relief as needed with thermostats set to begin intermittent sprinkling at 28°C. Beginning on d 42 of Exp. 2 (June 16, 1993), minimum and maximum daily temperatures were recorded in a manner similar to Exp. 1.

Carcass percent lean (containing 5% fat) was collected on individual pigs at SiouxPreme Packing Co., Sioux Center, IA, using total body electrical conductivity on the week that individual pigs weighed ≥ 104.5 kg.

Statistical Analysis. The pen of pigs was the experimental unit for all statistical analyses.

Exp. 1 was analyzed as a three-factor randomized complete block (fixed model) with all two- and three-way interactions included in the model. Planned orthogonal contrasts compared the NRC diets to all others (5F + L + 5FL), 5F to 5FL, and L to 5FL.

Exp. 2 and 3 were analyzed as a split plot design with duplicate barn as the whole plot and space and diet as the subplots. Planned orthogonal contrasts were used to examine linear and quadratic diet effects.

All statistical analysis was conducted using the GLM procedure as outlined by SAS (1982).

Death loss and pig removal data were analyzed by Chi squared analysis.

Results

Exp. 1. Live weight shrink from auction market to arrival was 9.5%, 9.3%, 4.9%, and 9.9% for Trials I through IV, typical of pigs previously purchased from these sources (Brumm and Peo, 1985; Brumm and Schricker, 1989; Brumm et al., 1989).

There were no three-way interactions between space allocation, season, and diet. The only significant ($P < .1$) two-way interaction was for ADFI for space allocation × diet and was due to the magnitude of the response to L diets for the .56 vs .78 m^2/pig treatments when compared to NRC diets.

The performance results for the main effects are presented in Table 4. Typical of previous trial results where space allocation was restricted (Kornegay and Notter, 1984; NCR-89, 1993), pigs given .56 m^2/pig vs .78 m^2/pig ate less feed ($P < .001$; 2.28 vs 2.43 kg/d) and grew slower ($P < .001$; .676 vs .710 kg/d) with no difference in gain:feed or carcass lean %. The slower rate of gain, when combined with similar carcass lean %, resulted in a slower ($P < .05$) rate of carcass lean gain (.257 vs

.267 kg/d). The number of pigs that died or were removed because of unacceptable gain or injury was higher ($P < .005$) for the .56 m^2/pig treatment (35 vs 12 pigs; 7.8% vs 3.8%).

During the first winter trial (Trial I), the daily maximum temperature was ≥ 23.3°F on 9 d, with 5 d occurring during the last 3 wk of the trial, when a majority of the pigs were already removed for slaughter. During Trial III, there were also 9 d that were > 23.2°F, with seven of these occurring during the last 3 wk.

During the first summer trial (Trial II), there were 65 d when the maximum recorded temperature was ≥ 29.4°C, and 34 d at ≥ 32.2°C. During the second summer trial (Trial IV), there were only 23 d of ≥ 29.4°C and only eight ≥ 32.2°C with five of the eight days occurring during the first 8 wk. Relative humidity remained in the 40 to 70% range during all trials, with more variation noted during the summer trials, especially Trial II.

Even with the cooler temperatures noted for Trial IV, pigs growing during the summer trials ate less feed (2.30 vs 2.41 kg/d; $P < .001$), grew slower (.678 vs .708 kg/d; $P < .005$) and had a slower rate of lean gain (.250 vs .273 kg/d; $P < .0001$), compared to pigs during the winter trials. There was no effect of season ($P > .1$) on feed conversion efficiency, variation in weight within a pen, carcass lean %, or the number of pigs dead or removed.

In this experiment, using pigs that would be classified as having a medium rate of lean gain (Augenstein et al., 1994), adding lysine to diets that contained an excess of energy (5FL vs 5F) had no effect on any of the performance traits reported.

However, when energy was added to a diet that already contained added lysine (5FL vs L) feed intake was decreased (2.26 vs 2.41 kg/d; $P < .005$) and gain:feed ratio increased (.312 vs .284; $P = .0001$).

Exp. 2. Similar to Trial IV of Exp. 1, heat stress during this summer experiment was minimal. From d 42 of the experiment, there were only 23 d with a recorded maximum temperature of ≥ 29.4°C, and none at ≥ 32.2°C.

There were no interactions between space allocation and diet ($P > .1$) for any performance traits. Table 5 presents the results for pig performance.

Unlike Exp. 1, there was no effect ($P > .1$) of space on ADFI. However, pigs given .56 m^2/pig vs .78 m^2/pig grew slower (.765 vs .795 kg/d; $P = .0005$), had a poorer gain:feed ratio (.301 vs .309; $P < .05$), and a slower rate of lean gain (.265 vs .271 kg/d; $P < .05$). There was no effect of space allocation on weight variation within a pen at time of first pig removal, carcass lean %, or number of pigs dead or removed.

Adding both lysine and energy, while maintaining a constant lysine:energy ratio resulted in a linear increase in ADG ($P < .01$), gain:feed ($P < .0001$), and rate of carcass lean gain ($P < .05$). There was no diet effect on carcass lean %.

Total lysine intake (as measured by disappearance) was calculated for each dietary weight period and the overall experiment. For Period 1, the pigs given .56 m²/pig had a higher (*P* < .05) lysine intake than the pigs given .78 m²/pig (.164 vs .157 kg). Overall, there was no effect of space allocation on total lysine intake per pig.

During Period 1, lysine intake increased (*P* < .005) with increasing amounts of lysine and energy in the diet (.159, .159, and .168 kg for CON, 2.5 GL, and 5.0 GL treatments, respectively). During Period 3, lysine intake decreased (*P* < .005; .427, .415, and .376 kg). The increase in intake for Period 1 followed by the decrease in Period 3 resulted in no difference (*P* > .1) in lysine intake due to diet for the overall period.

Exp. 3. Similar to Exp. 2, there were no interactions between space allocation and diet (*P* > .1). Table 6 presents the results for pig performance.

Unlike Exp. 2 and similar to Exp. 1, pigs given .56 m²/pig vs .78 m² ate less feed (2.363 vs 2.428 kg/d; *P* < .08). This resulted in a reduced (*P* < .05) rate of gain (.697 vs .728 kg/d), with no difference in feed conversion efficiency. Although there was no effect of space allocation on carcass lean %, the reduced rate of gain for the .56 m²/pig treatment, when combined with the similar carcass lean %, resulted in a reduced rate of lean gain compared to the .78 m²/pig treatment (.265 vs .276 kg/d; *P* < .005).

Adding both lysine and energy, while maintaining a constant lysine:energy ratio, resulted in a linear improvement in ADG (*P* =

.011) and gain:feed (*P* < .00001). The quadratic improvement in lean gain (*P* < .05) appears to be mostly a plateauing between the 2.5TL and 5TL treatments, similar to Exp. 2.

Discussion

Kornegay et al. (1993a) theorized that the most probable reason for reduced performance of nursery pigs given less space is an absolute decrease in energy intake. In Exp. 2 and 3, this hypotheses was not supported for the growing-finishing pig. In these experiments, the lysine to energy ratio was constant across all diets. The calculated total lysine and energy intakes were not different between the differing space allocations in Exp. 2 (Table 5) and yet, ADG was decreased with less space per pig and more pigs per social group.

Impaired efficiency of feed utilization due to chronic stress has been suggested by Paterson and Pearce (1991) as one mechanism by which crowding reduces growth. Using computer modeling to confirm field observations, Chapple (1993) suggested that the "stress" of being reared in a group reduces the capacity of the pig to deposit protein and that this causes a reduction in feed intake and efficiency of feed use. Chapple went on to hypothesize that when space is limited, stress is mediated through biochemical factors that direct down-regulated tissue growth, lower nutrient requirements, and reduce feed intake.

Kornegay et al. (1993b) concluded that the addition of lysine to diets of weanling pigs was not effective in overcoming the reduction in performance caused by a restriction in space allowance. The lack of space allocation x diet interactions in all experiments support these conclusions for growing-finishing pigs. Results of these experiments are also supported by recent NCR-42 (1993) results in which the reduction in ADG due to crowding of finishing pigs was not prevented by the addition of 5% added fat and .05% added lysine to control diets.

Nielsen and Lawrence (1993) reported that for 10 vs 15 pigs per pen (social group), there was no difference in the number of feeder visits per pig, feed intake per feeder visit, or feeder occupation time per pig per day. The 10 or 14 pigs per pen used in these experiments fall within this range and thus, the increase in number of pigs per pen does not explain the reduction in ADG reported in these experiments for the .56 m^2/pig treatment compared to the .78 m^2/pig treatment.

The decrease in ADFI for the diets with added fat in Exp. 1 and linear decrease in ADFI with increasing additions of dietary fat in Exp. 2 and 3 and the improvements in gain:feed ratio in all experiments are in agreement with the conclusions of Pettigrew and Moser (1991) regarding dietary fat additions to diets of growing-finishing pigs.

The lack of season x space interactions may be partially explained by the very cool summer noted for Trial IV of Exp. 1. Unlike Trial II, the temperatures recorded during Trial IV suggest that minimal heat stress occurred. Thus, the question of whether the effects of space restriction are more severe in warm or hot temperatures than in thermoneutral or cool conditions remains unanswered.

Implications

The lack of space x diet interactions in the three experiments suggest that the reduction in daily gain associated with a reduction in daily feed intake for crowded pigs is not due to a reduction in lysine or energy intake. These results suggest that the reduction in daily gain often associated with space restrictions can not be overcome by increasing the lysine and(or) energy content of the diet. The 28% reduction in space for the .56 m^2 treatment vs the .78 m^2 treatment resulted in 4.8% (Exp. 1), 3.8% (Exp. 2), and 4.3% (Exp. 3) reduction in ADG with no effect on gain:feed ratios in two of the three experiments.

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Table 1. Composition of diets in Exp. 1 (as-fed basis).

Item	Pig weight, kg							
	Arrival-50				50-market weight			
	NRC	5F	L	5FL	NRC	5F	L	5FL
Ingredient, % of diet								
Corn	78.30	73.25	78.15	73.10	84.20	79.15	84.05	79.00
Soybean meal (44% CP)	19.25	19.25	19.25	19.25	13.50	13.50	13.50	13.50
Dicalcium phosphate	1.05	1.15	1.05	1.15	.95	1.05	.95	1.05
Limestone	.85	.80	.85	.80	.80	.75	.80	.75
Salt	.30	.30	.30	.30	.30	.30	.30	.30
Vitamin/trace mineral premix[a]	.25	.25	.25	.25	.25	.25	.25	.25
Fat[b]	--	5.00	--	5.00	--	5.00	--	5.00
L-lysine·HCl	--	--	.15	.15	--	--	.15	.15
Composition								
Calculated CP, %	15.1	14.7	15.3	14.8	13.1	12.7	13.2	12.8
Lysine, %								
Calculated	.75	.75	.87	.86	.60	.60	.72	.71
Pooled sample analysis	.82	.77	.88	.86	.63	.60	.71	.70
Calculated ME, Mcal/kg	3291	3535	3285	3531	3307	3553	3302	3549
Calculated Lys/ME, g/Mcal	2.28	2.12	2.65	2.44	1.81	1.69	2.18	2.00

[a]Provided the following per kilogram of complete diet: vitamin A, 5,500 IU; vitamin D_3, 1,320 IU; riboflavin, 4.4 mg; niacin, 35.2 mg; d-pantothenic acid, 17.6 mg; choline chloride, 110 mg; vitamin E, 20 IU; vitamin K, 1 mg; vitamin B_{12}, .27 mg; Zn, 80 mg; Fe, 80 mg; Mn, 40 mg; Cu, 10 mg; I, 1 mg; and Se, .3 mg.

[b]CW-3800, Feed Energy Co., Des Moines, IA. Contained the following fatty acids (% of total fatty acids): 14:0, .9%; 16:0, 18.1%; 18:0, 7.6%; 18:1, 28.2%; 18:2, 37.3%; and 18:3, 4.7%.

Table 2. Starting dates for each trial in Exp. 1

Trial	Season	Starting Date
I	Winter	December 5, 1990
II	Summer	May 15, 1991
III	Winter	November 6, 1991
IV	Summer	April 22, 1992

Table 3. Composition of diets in Exp. 2 and 3 (as-fed basis).

	Pig weight, kg								
	Arrival-41			41-82			82-mkt		
	CON	2.5GL[a] 2.5TL[b]	5GL 5TL	CON	2.5GL 2.5TL	5GL 5TL	CON	2.5GL 2.5TL	5GL 5TL
Ingredient, % of diet									
Corn	72.85	70.305	67.76	76.55	74.005	71.46	80.25	77.705	75.16
Soybean meal (44% CP)	24.75	24.75	24.75	21.00	21.00	21.00	17.25	17.25	17.25
Dicalcium phosphate	1.05	1.05	1.05	1.10	1.10	1.10	1.15	1.15	1.15
Limestone	.80	.80	.80	.80	.80	.80	.80	.80	.80
Salt	.30	.30	.30	.30	.30	.30	.30	.30	.30
Vitamin/trace mineral premix[c]	.25	.25	.25	.25	.25	.25	.25	.25	.25
Choice white grease/tallow[d]	--	2.50	5.00	--	2.50	5.00	--	2.50	5.00
L-lysine·HCl	--	.045	.09	--	.045	.09	--	.045	.09
Composition									
Calculated CP, %	17.1	16.9	16.8	15.8	15.6	15.4	14.4	14.2	14.1
Lysine, %									
Calculated	.90	.93	.97	.80	.83	.86	.70	.73	.76
Exp. 2 pooled sample analysis	.85	.92	.93	.81	.86	.84	.66	.71	.77
Calculated ME, Mcal/kg	3282	3392	3502	3287	3397	3509	3293	3403	3513
Calculated lys/ME, g/Mcal	2.74	2.74	2.76	2.43	2.44	2.45	2.12	2.14	2.16

[a] GL = Exp. 2 using choice white grease.

[b] TL = Exp. 3 using tallow.

[c] Provided the following per kilogram of complete diet: vitamin A, 5,500 IU; vitamin D_3, 1,320 IU; riboflavin, 4.4 mg; niacin, 35.2 mg; d-pantothenic acid, 17.6 mg; choline chloride, 110 mg; vitamin E, 20 IU; vitamin K, 1 mg; vitamin B_{12}, .27 mg; Zn, 80 mg; Fe, 80 mg; Mn, 40 mg; Cu, 10 mg; I, 1 mg; and Se, .3 mg.

[d] Choice white grease contained the following fatty acids (% of total fatty acids): 14:0, 1.7%; 16:0, 29.9%; 18:0, 2.2%; 18:1, 19.0%; 18:2, 39.4%; and 18:3, 7.2%.

Table 4. Summary of pig performance, Exp. 1

	Space (m²/pig)			Season			Diet					P Values				
														Diet		
Item	.56[a]	.78[b]	SE	W[c]	S[d]	SE	NRC	5F	L	5FL	SE	Space	Season	NRC vs 5FL + 5FL	5F vs 5FL	L vs 5FL
No. pens	32	32		32	32		16	16	16	16						
Pig weight, kg																
Initial	20.7	20.6		20.3	21.0		20.7	20.7	20.8	20.6						
Final	110.5	111.3	.2	110.6	111.2	.2	110.4	110.3	111.0	111.9	.3	.009	NS[e]	.089	.0029	.076
CV[f]	12.4	12.0	.3	12.5	11.9	.3	11.3	13.4	12.1	12.1	.4	NS	NS	NS	NS	NS
ADG, kg	.676	.710	.03	.708	.678	.03	.678	.701	.687	.706	.048	<.001	<.005	.067	NS	NS
ADFI, kg	2.28	2.43	.06	2.41	2.30	.06	2.46	2.27	2.41	2.26	.088	<.001	<.001	<.005	NS	<.005
Gain:feed	.296	.292	.08	.293	.295	.08	.276	.308	.284	.312	.030	NS	NS	.0001	NS	.0001
Carcass lean, %[g]	49.2	48.8	.2	49.0	49.0	.2	49.1	48.7	49.1	49.1	.3	NS	NS	NS	NS	NS
Lean gain, kg/d[g]	.257	.267	.003	.273	.250	.003	.262	.265	.258	.263	.005	<.05	.0001	NS	NS	NS
Pigs dead or removed, %	7.8	3.8		4.5	8.4		4.7	4.2	8.9	6.8		<.005	NS			

[a]14 pigs/pen

[b]10 pigs/pen

[c]Winter

[d]Summer

[e]NS = not significant ($P > .1$)

[f]CV = Coefficient of variation of within pen weight when first pig removed for slaughter.

[g]Containing 5% fat (equation of NPPC, 1991).

Table 5. Summary of pig performance, Exp. 2

Item	Space (m²/pig) .56[a]	Space (m²/pig) .78[b]	SE	Diet CON	Diet 2.5GL	Diet 5GL	SE	P values Space	P values Diet Linear	P values Diet Quadratic
No. pens	12	12		8	8	8				
Pig weight, kg										
Initial	22.7	22.6		22.7	22.6	22.5				
Final	106.2	107.7	.3	106.8	106.9	107.2	.4	.005	NS[c]	NS
CV[d]	8.6	7.9	.5	7.6	7.8	9.4	.6	NS	.073	NS
ADG kg	.765	.795	.005	.764	.787	.789	.006	.0005	<.01	NS
ADFI, kg	2.549	2.578	.027	2.640	2.572	2.479	.033	NS	<.005	NS
Gain:feed	.301	.309	.003	.290	.306	.312	.003	<.05	.0001	NS
Carcass lean, %[e]	46.0	46.0	.3	46.4	45.8	45.8	.3	NS	NS	NS
Lean gain, kg/d[e]	.265	.271	.002	.263	.270	.271	.003	<.05	< .05	NS
Lysine intake, kg/pig										
Period 1(arrival to 41 kg)	.164	.157	.002	.156	.159	.168	.003	<.05	<.005	NS
Period 2 (41 to 82 kg)	.379	.375	.008	.374	.364	.391	.010	NS	NS	NS
Period 3 (82 kg to slaughter)	.404	.408	.008	.427	.415	.376	.009	NS	<.005	NS
Overall	2.24	2.22	.02	2.24	2.21	2.23	.03	NS	NS	NS
Pigs dead or removed, %	1.2	2.5		3.1	2.1	0		NS		

[a] 14 pigs/pen.

[b] 10 pigs/pen.

[c] NS = not significant ($P > .1$).

[d] CV = Coefficient of variation of within pen weight when first pig removed for slaughter.

[e] Containing 5% fat.

Table 6. Summary of pig performance, Exp. 3

	Space (m²/pig)			Diet				P Values		
									Diet	
Item	.56[a]	.78[b]	SE	CON	2.5TL	5TL	SE	Space	Linear	Quadratic
No. pens	12	12	8	8	8					
Pig weight, kg										
Initial	20.7	20.5		20.5	20.7	20.7	.1			
Final	106.1	106.3	.4	106.0	106.2	1-6.4	.6	NS[c]	NS	NS
ADG, kg	.697	.728	.006	.695	.712	.727	.008	<.05	.011	NS
ADFI, kg	2.363	2.428	.024	2.475	2.405	2.306	.030	.078	<.001	NS
Gain:feed	.296	.300	.002	.281	.297	.315	.003	NS	<.00001	NS
Carcass lean, %[d]	49.0	49.0	.3	49.0	49.2	48.9	.3	NS	NS	NS
Lean gain, kg/d[d]	.265	.276	.002	.261	.277	.274	.003	<.005	<.005	<.05
Pigs dead or removed, %	3.6	.8		2.1	1.0	4.2		NS		

[a]14 pigs/pen

[b]10 pigs/pen.

[c]NS = not significant ($P > .1$)

[d]Containing 5% fat.