

Two Year Summary of the Performance of Finishing Pigs in Hoop Structures and Confinement During Winter and Summer

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Summary and Implications

Finishing pigs were fed for two years in bedded hoop structures and a confinement building with slotted floors in central Iowa. When summer and winter feeding periods for two years were combined, the trials showed that the finishing pigs in hoops ate more feed, grew faster, and required more feed per unit of liveweight gain than confinement pigs. The mortality rate was similar and percentage of culls was higher for hoops compared with confinement. Also, the hoop pigs were fatter with smaller loin muscle area and a lower percentage of carcass lean and carcass yield compared with confinement pigs. The efficiency of lean gain was also poorer for the hoop pigs.

Because the hoops are cold structures, there were seasonal effects. The hoop pigs ate more feed, particularly in the winter, grew faster in the summer, and were less efficient particularly in the winter than the confinement pigs. The hoop pigs were fatter in the summer only and less efficient in converting feed to lean in the winter only. Also the hoop pigs had a greater incidence of roundworm infestations particularly in the later trials, in spite of a thorough deworming regimen.

Therefore, hoop pigs may need to be fed diets somewhat differently than the diets fed to confinement pigs to optimize lean growth, and the control of internal parasites in hoop pigs may need to be more aggressive than in confinement. Bedding use was approximately 220 lb per pig on a year round basis. Approximately 204 lb of bedding was used in summer and approximately 236 lb of bedding was used in winter.

Introduction

Growth, management, economic, and environmental information for finishing pigs in bedded hoop structures has been scarce. The Hoop Research Complex (HRC) was developed in 1997 at the ISU Rhodes Research Farm, Rhodes, IA to conduct research and demonstrations related to feeding pigs in hoop structures. The HRC has

three hoops and one mechanically ventilated modular confinement building with slatted floors. Comparing the two production systems provides information for improved management of finishing pigs in hoops in the Midwest.

During the winter of 1997-1998, a pretrial was conducted at the HRC. During 1998 to 2000 four trials were fed at the HRC, two summer trials (June through October/November) and two winter trials (November through April/May).

The objectives of the study were to document the performance of finishing pigs in hoops during the summer and winter, and to evaluate pig performance in hoops compared with pigs in a confinement housing system.

Materials and Methods

The summer trials started in June and the winter trials started in November 1998 and 1999. For each trial, three groups of pigs were placed in three (30 ft. x 60 ft.) bedded hoop structures (150 pigs per hoop). The fourth group was placed in a mechanically ventilated modular confinement building with slatted floors with six pens (22 pigs per pen). The three hoops and confinement were filled over a three-week period or less. Each unit was filled with one delivery of pigs that were weaned at the same time. The pigs were injected with ivermectin and vaccinated for erysipelas at the beginning of the trials. The pigs were wormed with Safeguard in the feed at approximately 120 lb A total of 2,249 pigs was marketed over the duration of the four trials. The pigs weighed approximately 33-35 lb at the beginning of the trials (Table 1).

The stocking densities for finishing pigs in hoop structures was 12 ft² per pig and 8 ft² per pig in confinement. With 12 ft² per pig, each (30 ft x 60 ft) hoop structure was designed to hold 150 pigs. The confinement pens (13.5 ft x 13 ft) were designed to hold 22 pigs per pen. In the trials, a hoop is defined as a pen. There were three pens of hoop pigs and six pens of confinement pigs for each of the four trials. All pigs were from terminal Duroc boars crossed on predominantly white sows. The pigs were a mixture of barrows and gilts.

Pigs were fed five diets in phase ad libitum during the trials. All diets were corn and soybean meal based and were fed in meal form. The diets were dispensed in each hoop by two round feeders with 12 feeding spaces each. The confinement pens contained a single round feeder with eight spaces. The hoops contained two waterers with two drinking spaces each and the confinement contained four nipple waterers per pen.

The hoop structures were operated as cold facilities that used cornstalk bales for deep bedding. The north end was kept closed during the winter and the south was left open. This allowed air to be exchanged at a sufficient rate to prevent condensation on the underside of the roof. Bedding was added

to maintain a relatively dry bedding pack. During summer, both ends were left open and a sprinkler system with a cycle timer was used during hot weather.

The confinement facility used a variable-speed fan to maintain a sufficient minimum ventilation rate during winter. A propane makeup air heater was used to maintain temperature. The facility used mechanical ventilation during the summer along with a sprinkler system controlled with a cycle timer to reduce heat stress.

The pigs were weighed every 28 days. Marketing began when a pen achieved an average weight of 240 lb. There were two marketings for each pen. On the first marketing, all pigs weighing 240 lb or more were marketed. At this time, the pigs were scanned for backfat and loin muscle area using real-time ultrasound by a certified technician. The pigs weighing less than 240 lb were returned to their respective pens and fed until the next marketing. When the remaining pigs in a pen averaged at least 235 lb, the second marketing occurred. All remaining pigs were marketed at this time. All pigs were transported to the Excel plant, Ottumwa, IA, for processing and slaughter checks.

The summer trials were marketed in October and November 1998 and 1999 and the winter trials were marketed in April and May 1999 and 2000. Slaughter checks were conducted by a veterinarian on approximately 10 confinement pigs and 30 hoop pigs for each marketing date.

The data were analyzed using GLM model of SAS. The experimental design was a split plot with pens nested within building type. The model used the variables-year, pen, housing type, and season. The number of pigs per pen was inherent to the housing system. Pens were not completely independent because of proximity to one another. Means presented are least squares means.

Results and Discussion

Pig performance in the hoop and confinement pens is shown in Table 1. The data are for four trials over 2 years. The pigs were started on trial at 34.5 and 33.9 lb, fed for 125.4 and 127.0 days, and marketed at 257.9 and 254.4 lbs. on average for the hoops and confinement, respectively. The adjusted days to 250 lb was 168.9 and 169.5 days for the hoops and confinement, respectively. Bedding use was 220 lb per pig in hoops, or approximately 1 lb. of bedding per pound of gain or 1.75 lb of bedding per day.

The hoop pigs ate more feed per day than the confinement pigs. The average daily feed intake (ADFI), which is the feed disappearance less the feed consumed by pigs that were not marketed (culls and mortalities), was 5% more for the hoop pigs ($P<.001$) (5.27 vs. 5.01 lb/d). If the feed for the pigs not marketed (culls and mortalities) was included, the average daily feed intake (AllADFI) was 4% more for the hoops ($P<.05$) (5.36 vs. 5.15 lb/d) (Table 1).

The hoop pigs grew approximately 3% faster than the confinement ($P<.001$) (1.80 vs. 1.75 lb/d) (Table 1). However, the hoop pigs were less efficient in converting feed to liveweight gain. The feed efficiency with feed removed for culls and mortalities (F/G) was 3% poorer for the hoop pigs ($P<.05$) (2.94 vs. 2.86 lb feed/lb gain). The feed efficiency with the feed for culls and mortalities included (AllF/G) was approximately 2% poorer for the hoop pigs ($P<.05$) (2.99 vs. 2.94 lb feed/lb gain) (Table 1).

The mortality rate was similar (3.9 vs. 3.4%) for hoops and confinement. The percentage of pigs that were culled or did not weigh 220 lb at marketing (Lights) was 3.1% for hoops and 1.7% for confinement. This may be due to the larger number of pigs per pen in the hoops.

The carcass and scan performance of the pigs in hoops and confinement is shown in Table 2. The pigs were scanned at approximately 245 lb after 120 days on feed.

The hoop pigs were 7% fatter ($P<.01$) (.88 vs. .82 in.) and had 5.5% smaller loineyes ($P<.001$) (6.14 vs. 6.50 sq. in.) (Table 2). The same trend was observed when the values were adjusted to 250 lb.

The carcasses from the hoop pigs had less lean ($P<.001$) (50.4 vs. 51.8%) and lower yield ($P<.001$) (74.3 vs. 75.6%) than the confinement pig carcasses. The rate of lean gain was less ($P<.05$) and efficiency of lean gain was 8% more ($P<.001$) for the hoop pigs than the confinement pigs (Table 2).

The seasonal interactions of pig performance in hoops and confinement for summer and winter are shown in Table 3. Each season has two trials, one for each year. The measures from Table 1 not listed in Table 3 had no seasonal interaction. Bedding use was 204 lb per pig in summer and 15% more or 236 lb per pig in winter.

The pigs in hoops ate 3% more feed during the summer and 7% more feed in the winter than the pigs in confinement ($P<.05$) with the feed removed for the mortalities and culls (ADFI) (Table 1). When the feed for the mortalities and culls was included (AllADFI), there was no difference in feed intake in the summer, but during the winter the hoop pigs ate 8% more feed than the confinement pigs ($P<.001$) (Table 3). Presumably the cold environment encouraged the hoop pigs to eat more feed.

The hoop pigs grew 5% faster in the summer than the confinement pigs ($P<.001$), but there was no difference in the winter.

The feed efficiency of hoop pigs was 7 to 8% poorer than the confinement pigs in the winter ($P<.05$) (F/G and AllF/G). This is probably because more of the feed nutrients were used for maintenance, i.e. to maintain body temperature. During the summer with the feed for mortalities and culls included, the feed efficiency (AllF/G) was 4% poorer for the hoop pigs ($P<.05$) (Table 3).

Pig mortality was lower in the summer (2.8 vs. 3.7%) but higher in the winter (5.0 vs. 3.1%) in the hoops compared with confinement. This may be related to the cold environment in the hoops during the winter. The percentage of pigs that were culled, or did not reach 220 lb at market, was higher in the

hoops compared with confinement during both seasons (summer -5.0 vs. 3.1%; winter -5.7 vs. 2.0%) (Table 3).

The seasonal interaction of carcass and scan data for summer and winter is shown in Table 4. The hoop pigs had 11 to 13% thicker backfat in the summer ($P < .001$), but did not differ in the winter compared with the confinement pigs. The efficiency of lean gain did not differ in the summer, but was 14% poorer in the winter for the hoop pigs ($P < .001$) (Table 4).

Slaughter check data is presented in Table 5. Overall incidence of pneumonia was more in the hoop pigs (36 vs. 18%), but rhinitis incidence was similar (37 vs. 33%). Liver scar incidence, an indication of roundworm infestation was much more in the hoop pigs (28 vs. 1%). Seasonally, pneumonia incidence was more in winter than summer, although rhinitis incidence was more in the

summer. In the winter, rhinitis incidence was less in the hoops than confinement, perhaps because of improved air quality in the hoops.

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Table 1. Performance of pigs fed in hoops and confinement (4 trials, 2 years).

Measure	Hoops		Confinement		
	Mean	SEM	Mean	SEM	
Start weight, lb	34.5	0.7	33.9	0.5	
End weight, lb ^a	257.9	1.3	254.4	0.9	
Weight gain, lb	223.5	1.5	220.5	1.1	
Days on feed	125.4	1.2	127.0	0.8	
Adjusted days to 250	168.9	0.8	169.5	0.5	
Bedding use per pig, lb ^{b,f}	220.1		0		
ADFI, lb/day ^c	5.27	.04	5.01	.03	***
ADG, lb/day	1.80	.01	1.75	.01	***
Feed/Gain, lb feed/lb gain ^d	2.94	.02	2.86	.02	*
AllADFI, lb/day ^c	5.36	.05	5.15	.04	**
AllF/G, lb feed/lb gain ^d	2.99	.03	2.94	.02	*
Mortality, % ^b	3.9	--	3.4	--	
Lights, % ^{b,e}	3.1	--	1.7	--	

SEM = standard error of the mean.

^aEnd weight is the liveweight at the farm prior to shipping to the plant.

^bNo statistical analysis performed on data.

^cADFI = Feed disappearance less the feed consumed by pigs that were not marketed ÷ number of pigs marketed ÷ days on feed.

AllADFI = Feed disappearance ÷ pigs marketed ÷ days on feed.

^dF/G = ADFI ÷ ADG.

AllF/G = AllADFI ÷ ADG.

^eLights = pigs not weighing 220 lb at marketing.

^fBedding use = total bedding ÷ no. of pigs at start of trial.

* $P < .05$, ** $P < .01$, *** $P < .001$.

Table 2. Carcass and scan performance of pigs fed in hoops and confinement (4 trials, 2 years).

Measure	Hoops		Confinement		
	Mean	SEM	Mean	SEM	
Scan liveweight, lb	243.4	1.5	244.6	1.0	
Test period, days	118.4	1.2	121.0	0.8	
Backfat, in.	0.88	.01	0.82	.01	**
Loin muscle area, sq. in.	6.14	.06	6.50	.04	***
Adjusted backfat, in. ^a	.90	.01	.84	.01	***
Adjusted LMA, sq. in. ^a	6.25	.05	6.59	.04	***
Lean, lb/pig	90.4	.7	93.7	.5	***
Lean, % ^b	50.4	.2	51.8	.1	***
Lean gain, lb/day on test ^b	.68	.01	.69	.01	*
FFLI, % ^c	47.2	.1	47.8	.1	**
Efficiency of lean gain, lb feed/lb lean gain	7.67	.09	7.09	.06	***
Yield, %	74.3	.2	75.6	.1	***

SEM = standard error of the mean.

^aAdjusted to 250 lb liveweight.

^bIncludes 0% fat, calculated with NPPC formula.

^cIncludes 0% fat, from slaughter checks.

*P<.05, **P<.01, ***P<.001.

Table 3. Seasonal interactions of pig performance measures fed in hoops and confinement (4 trials, 2 seasons, 2 years).

Measure	Summer		Winter		SEM	
	Hoop	Conf	Hoop	Conf	Hoop	Conf
Start wt., lb	33.3	35.1	35.6	32.7	1.0	.7
End wt., lb ¹	260.4	255.0	255.4	253.8	1.8	1.3
Weight gain, lb	227.1	219.9	219.9	221.1	2.2	1.5
Days on feed	121.0	123.2	129.8	129.8	1.7	1.2
Adjusted days to 250	158.1	162.1	179.8	177.0	1.1	.8
Bedding use, lb/pig ^{2,6}	204.4	--	235.9	--	--	--
ADFI, lb/day ³	5.29 ^c	5.13 ^b	5.26 ^{bc}	4.90 ^a	.06	.04 *
ADG, lb/day	1.88 ^a	1.79 ^b	1.72 ^c	1.71 ^c	.02	.01 ***
Feed/gain, lb feed/lb gain ⁴	2.81 ^a	2.86 ^a	3.07 ^b	2.86 ^a	.03	.02 ***
AllADFI, lb/day ³	5.35 ^b	5.33 ^b	5.37 ^b	4.98 ^a	.07	.05 ***
ALLF/G, lb feed/lb gain ⁴	2.85 ^a	2.97 ^b	3.14 ^c	2.91 ^{ab}	.05	.03 *
Mortality, % ²	2.8	3.7	5.0	3.1	--	--
Lights, % ^{2,5}	5.0	3.1	5.7	2.0	--	--

Note: Measures not reported from Table 1 had no seasonal interaction. Means in the same row with the same superscript do not differ.

SEM = standard error of the mean.

¹End weight is the liveweight at the farm prior to shipping to the plant.

²No statistical analysis performed on data.

³ADFI = Feed disappearance less the feed consumed by pigs that were not marketed ÷ number of pigs marketed ÷ days on feed.

AllADFI = Feed disappearance ÷ pigs marketed ÷ days on feed.

⁴F/G = ADFI ÷ ADG.

AllF/G = AllADFI ÷ ADG.

⁵Lights = pigs not weighing 220 lb at marketing.

⁶Bedding use = total bedding ÷ no. of pigs at start of trial.

*P<.05, **P<.01, ***P<.001.

Table 4. Seasonal interactions of carcass and scan performance measures of pigs fed in hoops and confinement (4 trials, 2 seasons, 2 years).

Measure	Summer		Winter		SEM	
	Hoop	Conf	Hoop	Conf	Hoop	Conf
Scan wt, lb	248.8	247.3	237.9	242.0	2.1	1.5
Test period, days	116.5	119.0	120.3	123.0	1.7	1.2
Backfat, in.	.98 ^c	.87 ^b	.77 ^a	.76 ^a	.02	.01 ***
Adj. backfat, in. ¹	.98 ^c	.88 ^b	.81 ^a	.79 ^a	.02	.01 **
FFLI, % ²	46.0 ^c	46.8 ^b	48.8 ^a	48.7 ^a	.17	.12
Eff. of lean gain, lb feed/lb gain	7.65 ^b	7.45 ^b	7.69 ^b	6.74 ^a	.13	.09 ***

Note: Measures not reported from Table 2 had no seasonal interactions.

Means in the same row with the same superscript do not differ.

¹Adjusted to 250 lb liveweight.

²Includes 0% fat, calculated with NPPC formula.

Table 5. Slaughter check data for pigs in hoops and confinement.

	No. of pigs	Pneumonia		Rhinitis		Liver scar incidence, %
		Score	Incidence, %	Score	Incidence, %	
<u>All hoops</u>	240	1.5	36	.8	37	28
Summer '98	60	1.5	32	1.0	48	23
Winter '99	60	1.8	55	0.2	15	5
Summer '99	60	1.7	43	1.5	60	40
Winter '00	60	1.2	15	.4	25	43
<u>All Confinement</u>	96	1.2	18	.60	33	1
Summer '98	24	1.2	17	1.1	46	0
Winter '99	24	1.3	29	0.3	25	0
Summer '99	24	1.0	4	.7	29	4
Winter '00	24	1.3	21	.5	33	0