Performance and Budget Analysis of Finishing Pigs in Hoop Structures and Confinement During the Winter: First Group Results

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Introduction

During the summer and fall of 1997, the Hoop Research Complex was developed at the Iowa State University (ISU) Rhodes Research Farm for comparing hoop structures to confinement for swine finishing. The site consists of three hoop structures and one modular confinement building. The hoops, each 30 ft × 60 ft, are oriented north/south. The south end of each hoop has a concrete floor (30 ft × 15 ft). Two round feeders with 12 feeding spaces and two waterers with two drinking spaces are in each of the hoops. The confinement building (16.5 ft × 88 ft) is mechanically ventilated and consists of six pens with totally slatted floors. Each pen (13.5 ft × 13 ft) has a round feeder with 8 feeding spaces and four nipple waterers. The confinement building liquid manure is removed by a pull-plug/manure scraper combination to storage in an outside concrete manure tank.

At 12 sq ft per pig, each hoop is designed to hold 150 pigs. At 8 sq ft per pig each confinement pen is designed to hold 22 pigs. These pen densities and group sizes are representative of current industry standards.

The hoops were completed during November 1997. However, the confinement building was not ready for pigs until mid-January 1998.

Methods

Feeder pigs weighing approximately 55 lb were delivered from Minnesota in December and placed in the hoops until the confinement building was complete. One of the hoops was divided lengthwise into two pens. On arrival, all pigs were tagged, injected with ivermectin, and vaccinated for erysipelas. The pigs were Baconmaker × PIC pigs with moderate lean gain potential. The pigs, a mixture of barrows and gilts, were secured from a single farm. The trial started in late January with 132 pigs in the confinement building and 369 pigs in the hoops. At that time, the pigs were weighed and randomly allotted to the hoops and confinement building to start the comparison trial.

In the hoop that was divided lengthwise, one half was stocked at the same pig density as the other hoops. The other half was stocked at lower density with surplus pigs. The performance of the pigs in the half-hoop stocked at a lower density was better than the other hoop pigs and therefore those pigs were not included in the experimental results.

The pigs were fed four diets ad libitum over the duration of the trial. The diets were corn–soybean meal diets in meal form. All pigs received the same diets. Shortly after arrival, swine dysentery was confirmed in the pigs. Therefore, tiamulin (Denagard) was administered in the water for a short period of time to control the outbreak and was continued in the feed at 10 g/ton until market. This treatment controlled the swine dysentery. Large round bales of cornstalks were used for bedding in the hoops.

Feed efficiency was calculated by dividing feed disappearance by live weight gain using on-farm weights. For pigs that died, the gain and estimated feed consumed was not included in the calculations.

The pigs were weighed every 14 days. When the pigs in a pen averaged 240 lb liveweight at the farm, marketing began. Marketing occurred on two dates for each pen. On the first marketing date, all pigs weighing 240 lb or more were marketed. The remaining lighter pigs were returned to their pen for additional feeding. The second marketing occurred when the remaining pigs averaged approximately 235 lb. All remaining pigs in a pen were marketed on the second marketing date. A pen of pigs is defined as a group of pigs that were fed together; in this case, a pen includes a hoop, a half hoop in the divided hoop, and a pen in confinement.

All pigs were processed at the Excel plant, Ottumwa, IA. Two confinement pens and one hoop were marketed on April 14 and on May 5. The remaining pens and hoops were marketed on April 28 and May 12. The pigs were individually

weighed and tattooed at the farm on marketing day. When the pen was ready for market all pigs were scanned for loin muscle area and backfat depth using real-time ultrasound. Slaughter checks of 10 confinement pigs and 30 hoop pigs were conducted at the packing plant on each marketing date.

Results and Discussion

Because of construction constraints of the new facilities, the comparison trial covers only the period from 100 lb to market or an average of 99 days from late January to early May. Overall means comparing the pigs in hoops to confinement are shown in Table 1. At marketing, 130 pigs from confinement and 358 pigs from the hoops were processed.

Pig identification by using plastic ear tags was a problem. Some tags were lost. Also the lettering on the tags was small and difficult to read. As a result there was some missing data that is reflected in the lower values shown in the "n" column. On some parameters missing data was 4%–6% (Tables 1 and 2).

All facilities were new. The hoops had housed all the pigs for approximately 30 days before the trial began and thus a bedding pack was well established. It is not known what effect housing the pigs in hoops for 30 days had on their trial performance. Swine dysentery undoubtedly affected pig performance. Remixing, weighing, and moving the pigs at 100 lb for allotment probably slowed overall pig performance.

Nevertheless, when pig performance is examined based on their housing systems—hoops and confinement–some trends are noted (Table 1). Overall the pigs grew and performed similarly. This is interesting because of the extreme differences in the housing systems. The pigs in hoops ate the same or slightly more feed (1.5%), grew slower (3.8%) ($P<.03$), and required more feed per pound of liveweight gain (6.2%) ($P<.007$) than the pigs in confinement. These trends are consistent with other reports of finishing pigs in hoops during winter months. The hoop pigs apparently use more of the feed they consume to maintain their body temperature during cold weather. Mortality was higher, but the percentage of pigs producing light carcasses (<163 lb) was less in the hoops compared with confinement. General performance of all of the pigs was poorer than expected. This was attributed primarily to the swine dysentery, the remixing of the 100 lb pigs at allotment, and the moderate lean growth potential of the pigs.

All pigs were scanned using real-time ultra sound at the 10^{th} rib for backfat and loin muscle area. The scan data is shown in Table 2. Using the scan data, lean values were calculated for the pigs (4). There were no differences in backfat, loin muscle area, % lean, or lean gain between hoops and confinement for these moderate lean gain pigs. The hoop pigs required about 9% more feed for lean gain than confinement pigs ($P<.02$) (Table 2). The poorer efficiency of lean gain for hoop pigs is consistent with the poorer feed efficiency for live gain (Table 1).

Health status monitoring. Representative health status monitoring (slaughter checks) were performed at the Excel processing plant in Ottumwa by a local veterinarian. Forty pigs from confinement were monitored or 10 from each marketing date. Pigs (120) from the hoops were monitored or 30 from each marketing date. Approximately 30% of pigs marketed were monitored for both housing systems.

Lung lesions were noted in 30% of the confinement pigs and in 14% of the hoop pigs monitored. Snout lesions were noted in 25% of the confinement pigs and 10% of the hoop pigs monitored. Septal deviation findings were similar at 15% of the confinement pigs and 13% of the hoop pigs monitored. This information indicates that the pigs in confinement had a poorer overall respiratory health than the pigs in confinement. Mycoplasma pneumonia and atrophic rhinitis are examples of common respiratory diseases that cause these problems.

All pigs were parasite-free with no skin lesions reported and only one pig in hoops with liver lesions. Skin lesions are an indication of external parasites and liver lesions are an indication of internal parasites.

Cost of production. The pigs in this trial were started at approximately 100 lb. However, the starting weight of 100 lb is uncommon for finishing pigs. A budget that is more comparable with the industry norm was prepared for a weight range of 50 lb to market weight. To project the budgets for a 50–lb start weight, an additional 31 days was used. Therefore, 130 days or 2.8 turns per year is the budgeted interval.

The budget comparisons in Table 3 are based on a cost of $180 per pig space for a confinement operation and $55 per pig space for the hoop system. Fixed costs are calculated at 13.2% of total investment for confinement and 16.5% for hoops.

The confinement facilities are depreciated over 15 years (6.7% annually), whereas the hoops are at 10 years (10% annually). Insurance and taxes represent 1.5% of fixed investment. Ten percent interest is assumed on the average investment level (5% in initial investment) for both systems. Fuel, repairs, utilities, vet, medical, marketing and miscellaneous are based on Iowa State University livestock enterprise budgets (1,3, and 5). The bedding cost is for 200 lb of cornstalks per pig. For the budget, a 1,200–lb bale was valued at $20.00. Labor was valued at $7.50 per hour and assigned at .21 hours per head for both the confinement and hoop pigs.

Feed efficiency was 3.46 for the confinement and 3.67 for the hoops. The resulting efficiency difference of .21 favors confinement for overall feed efficiency. Much of this trial took place during the winter. Many feel that feed efficiency for hoop pigs is more adversely affected during the winter months. With a feed cost of 6¢ per lb the resulting feed cost for confinement and hoops are $40.69 and $43.16, respectively (Table 3). This difference of $2.47 per pig marketed represents the third greatest cost difference between the two systems. A point to note is that, as indicated previously, the hogs had swine dysentery. Thus, the overall feed efficiency was likely impacted for both hoop and confinement pigs. The difference, however, between the systems should remain similar.

The total overall production cost per hundred lb for a 250 lb market pig is $37.97 for confinement and $38.04 for the hoops. The total cost of production is similar. The major differences are lower fixed costs and higher operating costs (feed and bedding) for the pigs in hoops.

Investment, feed efficiency,feed cost sensitivity.

Items such as facility investment, feed efficiency, feed cost, interest cost, etc., can have a significant impact on the overall cost comparison of production systems. These can vary between systems or over time. For these reasons, a sensitivity analysis is provided.

Table 4 shows the sensitivity of production cost per cwt to feed conversion and confinement facility investment. For Table 4, the feed conversion of confinement is held constant at 3.46 and feed conversion for hoops is allowed to fluctuate. There are many variations in types of facility investment. Although construction costs vary widely for all types of growing systems, the per–pig cost declines with size of the system and as the number of pigs housed at a site increases. For this table confinement facility expense is allowed to fluctuate from $140 per pig space to $220 per pig space. Table 4 shows that as the feed efficiency differences decrease (hoops consume relatively less) and confinement construction investment increases, the hoop system becomes relatively more attractive.

Table 5 shows the sensitivity between the cost of complete feed and confinement construction cost. In both Table 4 and Table 5 all other factors were held constant according to those values in the budget (Table 3). With the continuation of these studies, to determine seasonal and other factors, the budgets and sensitivity analysis should become more conclusive.

Conclusions

Overall performance of moderate lean pigs in hoops and confinement was similar during the winter. For this trial, hoop-finished pigs grew slightly slower and were less efficient in live gain and lean gain. Average backfat thickness and carcass lean percentage were similar.

Total cost per hundred lb of pork produced was similar between the systems; however, there were differences in the cost structure. The biggest cost differences were facility, bedding, and feed expense between pigs fed in hoops and confinement. The budget was prepared for a winter group of moderate lean pigs.

This was the first trial at the Rhodes Farm Hoop Research Complex. Subsequent trials should provide more definitive information. Seasonal and genetic differences are expected. Preliminary results for the second group, a summer group, suggest that this will be the case. Feed usage, average daily gain, etc., differences do not appear to be as great during a summer or milder season. Further study will clarify these results.

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Table 1. Performance of pigs finished in confinement and hoops, January–May, 1998.

	Hoops			Confinement			
	Mean	n	SEM	Mean	n	SEM	
Start wt., lb	101.2	337	1.6	96.9	125	1.1	
End wt., lb[a]	251.8	358	3.1	254.4	130	2.2	
Wt. gain, lb	150.3	337	2.8	157.6	125	2.0	*
ADFI (average daily feed intake), lb/d[b]	6.03	3	.12	5.94	6	.08	
ADG (average daily gain), lb/d[c]	1.53	337	.02	1.60	125	.01	**
F/G (feed efficiency) lb feed/lb gain	3.95	3	.05	3.72	6	.04	***
Days on feed, d	99	358	2.1	99	130	1.5	
Ave. hot carcass wt., lb [f]	186.7			186.1			
Mortality, % [f]	3.0			1.5			
Lights, % [d,f]	5.5			6.2			
Bedding use/pig, lb [e,f]	168.0			-			

The n values are equal to the number of individual identifiable pigs except for feed values, then the n value is equal to the number of pens of pigs. SEM = standard error of the mean.
[a]Ending weight. is the liveweight at the farm on the day the pigs were shipped to the plant.
[b]ADFI is feed disappearance per pig divided by days on feed.
[c]ADG is based on farm end weight.
[d]Lights are defined as pigs that did not produce a 163–lb carcass.
[e]A bedding pack had been established prior to the beginning of this trial.
[f]No statistical analysis was performed on this data.
*P<.08.
**P<.03.
***P<.007.

Table 2. Performance of pigs in hoops and confinement using real-time ultrasound scan data.

	Hoops			Confinement			
	Average	n	SEM	Average	n	SEM	
Live weight, lb	241.9	358	6.3	243.7	128	4.6	
Test period, d	92.3	358	4.3	92.3	128	3.1	
Backfat, in.	1.16	356	.06	1.14	127	.04	
Loin muscle area, sq in.	5.36	356	.10	5.29	127	.07	
Lean, lb/pig	84.6	356	1.5	85.1	127	1.1	
Lean, %	47.3	356	.60	47.3	127	.43	
Lean gain, lb/d on test	.50	335	.01	.53	122	.01	
Efficiency of lean gain, lb feed/lb lean gain	12.2	3	.3	11.2	6	.2	*

The n values are equal to the number of individual identifiable pigs except for feed values, then the n value is equal to the number of pens of pigs. SEM = standard error of the mean.

*P<.02.

Table 3. Swine grow-finish production budget for confinement and hoops.

Item	Confinement	Hoop	Difference
Estimated average days from 50 lb to market	130	130	
Estimated pounds of feed consumed per lb sold, 50 lb to market	3.46	3.67	-0.21
Facility Investment			
Building (per pig space) (8 ft^2/pig confinement; 12 ft^2/pig hoop)	$180.00	$55.00	$125.00
Feed & manure handling equipment (per pig space)	$36.00	$36.00	
Total initial investment (per pig space)	$216.00	$91.00	$125.00
Total investment per pig marketed (2.8 turns per year)	$77.14	$32.50	$44.64
Fixed Cost			
Interest, taxes, depreciation, insurance (13.2% for confinement; 16.5% for hoops) (per cwt, 50lb to market)	$10.18	$5.36	$4.82
Total fixed cost	$10.18	$5.36	$4.82
Operating cost (per cwt 50lb to market; 196 lb of gain)			
Feeder pigs (50 lb pig)	$35.00	$35.00	
Interest on feeder pig (10% for 4 months)	$1.17	$1.17	
Fuel, repairs, utilities	$2.00	$0.50	$1.50
Bedding (1,200 lb bale @ $20.00 each)		$3.33	-$3.33
Feed ($.06/lb feed)	$40.69	$43.16	-$2.47
Vet/medical	$1.50	$1.50	
Marketing/misc.	$1.50	$1.50	
Interest on fuel, feed, etc. (10% for 2 months)	$0.76	$0.83	-$0.07
Labor (0.21hr/pig @ 7.50/hr)	$1.58	$1.58	$0.00
Death loss cost	$0.54	$1.18	-$0.64
Total operating cost	$84.74	$89.74	-$5.01
Total cost (per pig marketed)	$94.92	$95.11	-$0.19
Total cost per cwt market weight live (250–lb market hog)	$37.97	$38.04	-$0.08

Table 4. Building investment and feed efficiency sensitivity of production cost per cwt for confinement versus hoop structures

	Confinement building investment				
Feed Efficiency difference	**$140**	**$160**	**$180**	**$200**	**$220**
0.2	$1.13	$1.51	$1.89	$2.26	$2.64
0	$0.18	$0.55	$0.93	$1.31	$1.68
-0.2	-$0.78	-$0.40	-$0.03	$0.35	$0.73
-0.4	-$1.74	-$1.36	-$0.98	-$0.61	-$0.23
-0.6	-$2.69	-$2.32	-$1.94	-$1.56	-$1.19

Overall net cost of confinement over hoops.
A negative number indicates that confinement is lower cost.
Assuming feed cost of $.06 per lb of complete feed.

Table 5. Building investment and feed cost sensitivity of production cost per cwt for confinement and hoop structures

	Confinement building investment				
Feed cost per lb	**$140**	**$160**	**$180**	**$200**	**$220**
0.05	-$0.66	-$0.28	$0.09	$0.47	$0.85
0.06	-$0.83	-$0.45	-$0.08	$0.30	$0.68
0.07	-$1.00	-$0.62	-$0.24	$0.13	$0.51
0.08	-$1.16	-$0.79	-$0.41	-$0.03	$0.34
0.09	-$1.33	-$0.95	-$0.58	-$0.20	$0.18
0.10	-$1.50	-$1.12	-$0.74	-$0.37	$0.01

Overall net cost of confinement over hoops.
A negative number indicates that confinement feeding is less costly.
Assuming 3.46 and 3.67 FE for confinement and hoops, respectively.