1976

EC76-219 Nebraska Swine Report

R. D. Fritschen
University of Nebraska-Lincoln, bobnhaz@hotmail.com

E. R. Peo Jr.
University of Nebraska-Lincoln

Donald L. Ferguson
University of Nebraska-Lincoln

Murray Danielson
University of Nebraska-Lincoln

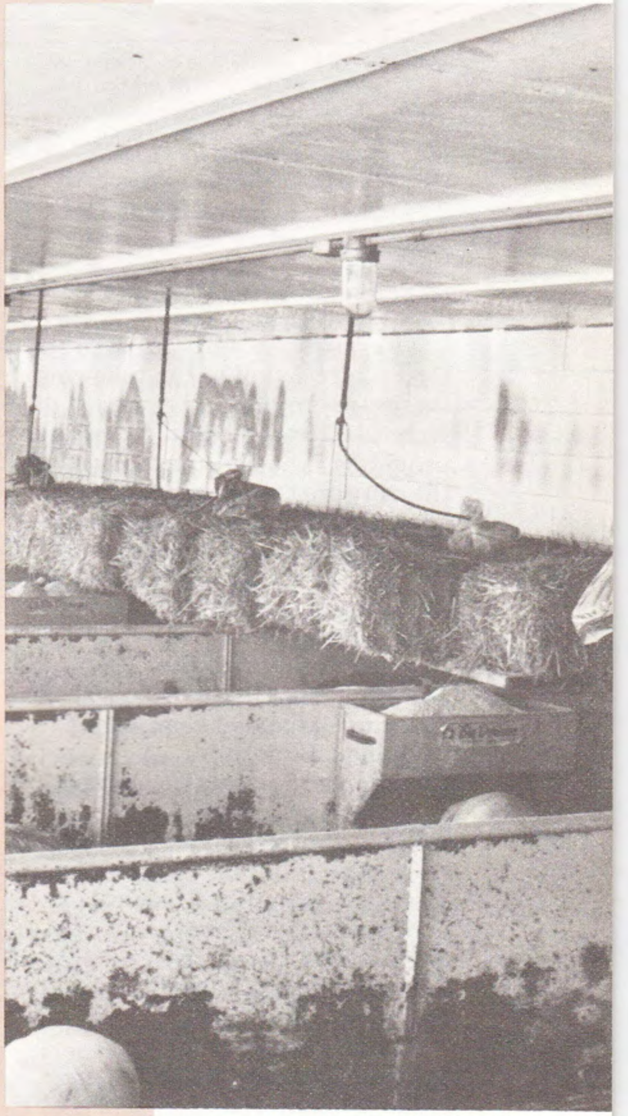
William Ahlschwede
billahls@neb.rr.com

See next page for additional authors

E. C. 76-219

1976

NEBRASKA SWINE REPORT



- Breeding
- Disease Control
- Nutrition
- Economics
- Housing

Prepared by the staff in Animal Science and cooperating Departments for use in the Extension and Teaching programs

University of Nebraska-Lincoln
Institute of Agriculture and Natural Resources

L. E. Lucas
Director, Extension Service

H. W. Ottoson
Director, Experiment Station

T. E. Hartung
Dean, College of Agriculture

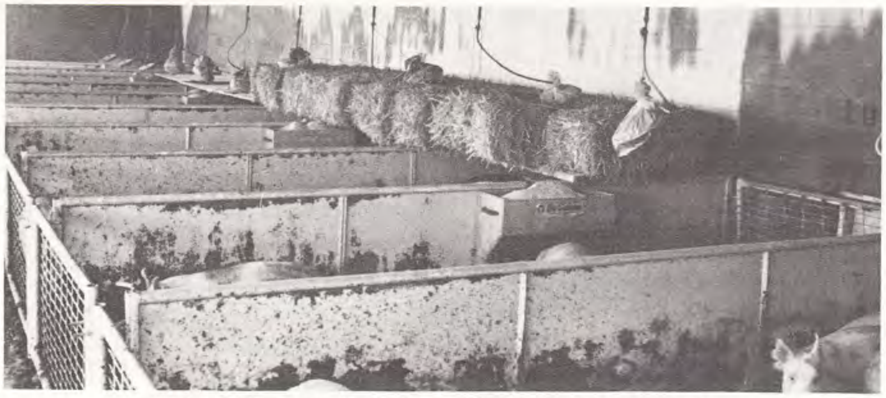
Support Acknowledged

The authors wish to express their appreciation to the following for grant or product support of Nebraska Research and Extension programs. The dedicated effort of the support personnel in the laboratories and research units is acknowledged and appreciated.

American Cyanamid Company, Princeton, New Jersey
Bettcher Industries, Inc., Vermillion, Ohio
Calcium Carbonate Company Quincy, Illinois
Commercial Solvents Corporation, Terre Haute, Indiana
Dawes Laboratories, Inc., Chicago, Illinois
Diamond Shamrock Chemical Co., Newark, New Jersey
Eli Lilly and Company, Indianapolis, Indiana
Farmland Industries Kansas City, Missouri
Fats and Protein Research Foundation, Inc., Desplaines, Illinois
George A. Hormel Packing Company, Fremont, Nebraska
Hoffman-LaRoche, Inc., Nutley, New Jersey
Merck and Company Rahway, New Jersey
National Pork Producers Council, Des Moines, Iowa
National ByProducts, Omaha, Nebraska
Nebraska Farmer, Lincoln, Nebraska
Nebraska Pork Producers Association
Pfizer, Inc., Terre Haute, Indiana
Pioneer Hi-Bred International, Inc., Des Moines, Iowa
Rhodia, Inc. (Hess and Clark Div.), Ashland, Ohio
Sargent Calcium Products Company, Weeping Water, Nebraska
S. B. Penick and Company, New York, New York
Shell Chemical Company, Agricultural Division, San Ramon, California
Townsend Engineering Des Moines, Iowa
Urschel Laboratories, Inc., Valparaiso, Indiana
U.S.D.A., ARS, WRRL, Berkeley, California
Waldo Farms, DeWitt, Nebraska
Wilson Foods, Inc. Omaha, Nebraska

Contents

Issued January 1976, 10,000



Catalytic, straw, and plywood hovers were compared.

Pig Performance During Winter

Zone Heat, Hovers, or Housing?

R. D. Fritschen
District Extension Specialist (Animal Science)[1]

The best use of feed energy may be achieved when the pig is within the thermoneutral zone. When the cost of maintaining an environment in the pig's thermoneutral zone is greater than the economic return, management options must be considered to reduce production cost with a minimum deviation from the thermoneutral zone.

Three buildings with 12 pens each were used to study the pig's response to temperature managment. A total of 360 pigs were involved in a two-phase study from December 12, 1974 to April 7, 1975. The pigs were purchased from a feeder pig broker and were received on December 5 after being in transit about 26 hours. The purchase weight was 36.5 pounds and the delivery weight about 31 pounds.

Pigs were unloaded into two environmentally regulated (ER) buildings where heater thermostats were initially set at 87°F. Floor temperature was maintained at about 70-74°F. The ER buildings were chosen because they are the only buildings with water medicators. Medicated water was immediately available for the pigs and they were maintained on it for the pre-test acclimation period of one week.

[1]Appreciation is expressed to Dan Huwaldt for feeding and care of pigs.

Early Growing Period Study

On December 12, pigs were allotted based on weight and sex to 36 pens in three buildings. The objective of one phase of the study was to measure the effect and cost of temperature management in a modified open-front (MOF) building versus two environmentally regulated (ER) buildings managed two different ways. All buildings had pens that were 6′ × 16′ and had floors 50 percent slotted.

Three temperature management treatments were compared in the MOF building; catalytic zone heat (7200 Btu rating), plywood hover, and straw hover. The catalytic heaters, plywood and straw hovers were maintained at a floor height of 36 inches. The hovers covered nearly 50 percent of the pen area.

Table 1. Effect of zone heat or hovers on pig performance in a MOF building during winter.[ab]

	Catalytic zone heat	Plywood hover	Straw hover
Avg. bg. wt., lb	37.7	37.6	37.6
Avg. final wt., lb.	69.0	68.7	71.4
No. pigs	60	30	30
No. pen reps	6	3	3
Avg. da. ga., lb.	.96	.94	1.01
Feed:Gain	2.87	3.02	2.92
Feed & utility cost per cwt. gain	$25.68	$24.09	$23.36

[a]Dec. 12, 1974 – Jan. 14, 1975.
[b]Avg. low temp inside bldg. = 29.3°F.
Avg. high temp inside bldg. = 51.0°F.
Avg. high temp. outside bldg. = 29.1°F.
Avg. low temp outside bldg. = 7.6°F.

Table 2. Effect of housing on performance of pigs during the early growing phase — winter.[a]

Bldg. type	"B" Modified open-front	"D" Env. reg. optimum ventilation	"F" Env. reg. minimum ventilation
No. pigs	120	120	120
Avg. bg. wt., lb	37.7	37.9	37.8
Avg. final wt., lb	69.0	69.1	68.6
Avg. da. ga., lb	.97	.94	.93
Feed:Gain	2.92	2.84	2.83
Feed & utility cost per cwt. gain	$24.68	$28.10	$26.97

[a]Dec. 12, 1974 – Jan. 14, 1975.

Buildings D and F are identical ER units. For this study building D was ventilated by two pit fans plus a continuous wall fan with motorized shutters. Building F was ventilated only by two pit fans. Building D was labeled "optimum ventilation" and building F "minimum ventilation". The initial phase of the study began December 12 and lasted 34 days.

The effect of zone heat or hovers during the early growing period on pigs in a MOF building in winter is shown in Table 1.

In general, gain and feed efficiency among all pigs was substandard. Treatment effect on gain shows that pigs with the straw hover gained slightly faster than either those with the plywood hover or catalytic heaters. Pigs with the plywood hover had the poorest feed efficiency, while there was little difference between catalytic zone heat and straw hovers.

Since utilities such as propane and electricity are used in swine housing primarily for a feed sparing effect, the utility cost was added to the feed cost to get a feed and utility cost per hundredweight gain. When this was done the straw hovers reduced the feed/utility cost $2.32 per hundredweight as compared to catalytic zone heat and $.73 per hundred-weight as compared to plywood hovers. A maximum/minimum thermometer was used to record high and low temperatures daily. The average low temperature inside the building was nearly identical to the average high outside. The average

(continued on next page)

Zone Heat, Hovers, or Housing?

(continued from page 3)

high temperature recorded in the center of the building, about 60 inches above floor level, was 51°F. Temperatures just under the straw hover but about 34 inches above floor level were taken at intermittent times and ranged from a low of 46°F to a high of about 70°F.

Table 2 summarizes the combined treatments in the MOF and compares it with building D (optimum ventilation) and building F (minimum ventilation).

There was little difference between buildings in growth rate or feed efficiency. However, the trend toward slightly better gain and slightly more feed required per unit gain in the MOF is consistent with previous winter studies. The pigs in the MOF building had a feed/utility cost per hundredweight gain of $24.68, which was $3.42 less than for the ER optimum ventilation building and $2.29 less than the ER minimum ventilated building. The optimum ventilation building fans had a maximum rating of 2712 cfm and a minimum volume of 1746 cfm while the minimum ventilated building fans were rated at a constant volume of 1200 cfm.

Gain and feed efficiency between buildings for the total growing and finishing period is shown in Table 3. Pigs in the MOF building gained slightly faster than pigs in either ER building. Feed efficiency in the MOF and ER optimum ventilated buildings was identical. Pigs in the ER minimum ventilated building were slightly more efficient than those in the other two houses. The three temperature moderating treatments were continued in the MOF building for the balance of the study.

The difference in feed/utility cost per hundredweight was not as great between buildings D and F at the end of the study as was noted at the end of the initial 34 day period (Table 2). This was because during the first 34 days the small pigs were not materially contributing to the heat budget of their respective houses. During the finishing period the pigs generated more body heat, which under proper ventilation practices, replaced heat otherwise supplied by the space heaters. It should be remembered that all pigs were housed in the two ER units for a one week period prior to being placed on test. Therefore, those moved into the MOF building had to reacclimate themselves to a lower temperature.

The comparision between building D and F suggests that if building D was ventilated at recommended or optimum levels for winter that this type of unit may be overventilated during this period of the year. The difference in feed/utility cost per hundredweight between buildings D and F was $.93 less in favor of the minimum ventilated building. Only $.08 difference per hundredweight gain existed between the MOF and minimum ventilated ER building. Perhaps the greatest difference is the one emphasized in the 1973 Swine Report, where it was stated that the construction cost for building B was $2.58 per square foot less than building D or F.

Death loss by building was as follows:

MOF Bldg.
1 Lameness and respiratory
1 Respiratory
1 Anal stricture
3 Total

ER Bldg. D
2 Unknown
2 Respiratory
4 Total

ER Bldg. F
3 Respiratory
3 Total

Respiratory problems persisted for the entire study. The poor health level was generally reflected in the gain and feed efficiency which were considerably poorer than in previous studies. High and low temperatures were recorded daily. The average temperatures by the month are shown in Table 4.

The average low temperature increased steadily in the MOF building reflecting the pigs' increased contribution to the heat budget of the building as they increased in size. It is important to know that, especially for the MOF building, the temperatures recorded were at a point near the end of the pen over the slats, opposite the end of the pen where the pigs were sleeping. The temperature in the immediate pig sleeping area may be slightly higher. A

Table 3. Effect of building management on pig performance.[a]

Building	"B" Modified open-front	"D"[b] Env. reg. optimum ventilation	"F"[c] Env. reg. minimum ventilation
No. pigs	120	120	120
Avg. bg. wt., lb	37.7	37.9	37.8
Avg. final wt., lb	201.3	197.0	198.8
Avg. da. ga., lb	1.40	1.35	1.38
Feed:Gain	3.50	3.50	3.44
Feed utility $/cwt.	$23.31	$25.32	$23.39

[a]Dec. 12, 1974 – Apr. 7, 1975.

[b]Two pit fans plus continuous wall fan with motorized shutters.

[c]Two pit fans.

Table 4. Effect of building type & management on temperature (°F).[a]

Monthly Average	Outside		"B" Modified open-front		"D" Env. reg. optimum ventilation		"F" Env. reg. minimum ventilation	
	Low	High	Low	High	Low	High	Low	High
Dec. 20–31	12.7	31.3	27.8	48.8	57.0	71.4	61.4	67.8
Jan.	10.3	31.0	31.7	53.7	59.6	71.5	52.7	64.5
Feb.	10.7	27.8	35.4	53.2	59.2	70.3	49.2	58.7
Mar.	20.0	38.3	38.4	59.4	58.0	70.8	51.2	63.4
Apr. 1–7	22.8	40.3	39.3	57.8	53.4	66.9	50.4	58.1
Avg. temp.	—	—	34.5	54.6	57.4	70.2	53.0	62.5
Individual Extreme Temp.	−23[b]	70.0[c]	10.0[d]	68.0	52.0	77.0	41.0	72.0

[a]Dec. 20, 1974 – Apr. 7, 1975.

[b]Feb. 9.

[c]Mar. 19.

[d]Jan. 11. Outside wind chill factor<−70°F.

Table 5. Relationship between building type temperature and performance.

	"B" Modified open-front	"D" Env. reg. optimum ventila-tion	"F" Env. reg. minimum ventila-tion
Avg. bldg. temp. °F			
Low	34.5	57.4	53.0
High	54.6	70.2	62.5
Performance			
Avg. da. ga., lbs.	1.40	1.35	1.38
Feed:Gain	3.50	3.50	3.44

smaller amount of air was being moved in building F than in building D, thus a corresponding lower thermostat setting was maintained. The overall effect of average temperature on performance is shown in Table 5.

The gain and feed efficiency are quite similar for the three buildings in view of the large difference in temperature. Factors other than temperature alone appear involved in optimum performance for growing-finishing pigs. These factors could include an interrelationship between temperature, drafts, moisture and dust. Possibly, the effectiveness of the pig's thermoregulatory mechanisms has been underestimated, particularly in groups.

Summary

Straw hovers appear to be an effective method of temperature management for pigs during the early growing period. Plywood hovers are less effective. Catalytic zone heat enhanced performance but the cost of operation made it less attractive.

The difference between the two ER buildings suggest that this type of building may be overventilated during winter. It appears that for those producers with an ER growing-finishing building a reduction in amount of air movement may be beneficial to pig performance as well as lowering utility usage. For producers a trial and error approach is suggested. Start the ventilation low and increase it until a satisfactory level is reached.

The MOF building during winter supported performance on a level equal to an ER building and had a lower feed/utility cost per hundredweight gain.

"To Worm or Not to Worm"

E. R. Peo, Jr.
Professor, Swine Nutrition

Donald L. Ferguson
Professor, Parasitology

To paraphrase Shakespeare, "to worm or not to worm" is a question often asked by producers concerning parasite control in swine. When pigs were raised on pasture, the answer to the worming question was invariably "yes."

Pasture or dirt dry lots become contaminated with eggs of such parasites as the large intestinal roundworm, whipworms, lungworms and nodular worms. The pigs become infected with the parasites by picking up the eggs or parasite larvae from the soil or by eating intermediate hosts of parasites such as earthworms. The eggs are produced by mature parasites living in the body of the pig and are passed out in the manure. The parasite cycle therefore can go on and on.

Can The Cycle Be Broken?

Recent changes in production methods have raised a question as to whether or not the parasite cycle is broken when pigs are raised in confinement and on slatted floors. The manure from pigs goes through slats into a collection pit below. Thus, the chance for reinfection with parasite eggs should be reduced greatly since the egg-carrying manure is gone. But, not all of the manure passes through the slats so there is still ample opportunity for pigs to become infected with parasites, particularly the large roundworm. Unanswered is the question "does it pay to worm pigs reared their entire life on slatted floors?"

A recent experiment at the Nebraska Agricultural Experiment Station helps answer this question.

Sixty-four barrows from dams that had not been wormed were used. The pigs were farrowed in solid, concrete floor pens and thus had access to sow manure but were never on pasture or in dirt dry lots. The barrows were taken from the farrowing house to a completely enclosed, ⅔ slatted floor, growing-finishing unit.

Two pens of 8 pigs/pen were assigned to each of four treatments:

1. Un-wormed control.
2. Wormed with Atgard (Shell).
3. Wormed with Tramisol (American Cyanamid).
4. Wormed with Banminth (Pfizer).

No antibiotics were included in the diets. Fecal samples were obtained from all pigs before worm-

(continued on next page)

Table 1. Value of wormers for G-F swine reared on slatted floors.[a]

	Treatments			
	Control	Wormed[b]		
	(not wormed)	Atgard	Tramisol	Banminth
No. pigs/treatment[c]	16	16	16	16
Initial wt., lb	68	67.5	68	67.5
Avg. daily gain, lb	1.68	1.69	1.62	1.56
Avg. daily feed intake, lb	6.00	5.74	5.24	5.57
Feed/gain ratio, lb	3.60	3.39	3.22	3.59
Worm Count[d]				
Initial (before worming)	2	0	0	0
Mid-trial	236	7.3	2.2	0.3
Final	260	9.1	2.5	10.9
Liver Damage[e]				
Score	2.1	1.4	2.0	1.7
Turbinate atrophy				
Nasal spacing, cm	0.52	0.47	0.52	0.62

[a]Completely enclosed house, ⅔ slatted floor.

[b]Wormed once according to manufacturers' recommendations.

[c]Two pens, 8 pigs/pen.

[d]Worm eggs/gram of feces (mostly large roundworms).

[e]Values used to score livers were: 1 = no lesions; 2 - 10-50 lesions; 3 - 50-100 lesions; 4 = more than 100 lesions.

"To Worm or Not to Worm"

(continued from page 5)

ing to determine the initial egg count. Samples were also taken for egg counts mid-way through the experiment and at the end. The pigs were wormed only once according to the manufacturers' recommendations. Results of the study are shown in Table 1.

Feed Saved

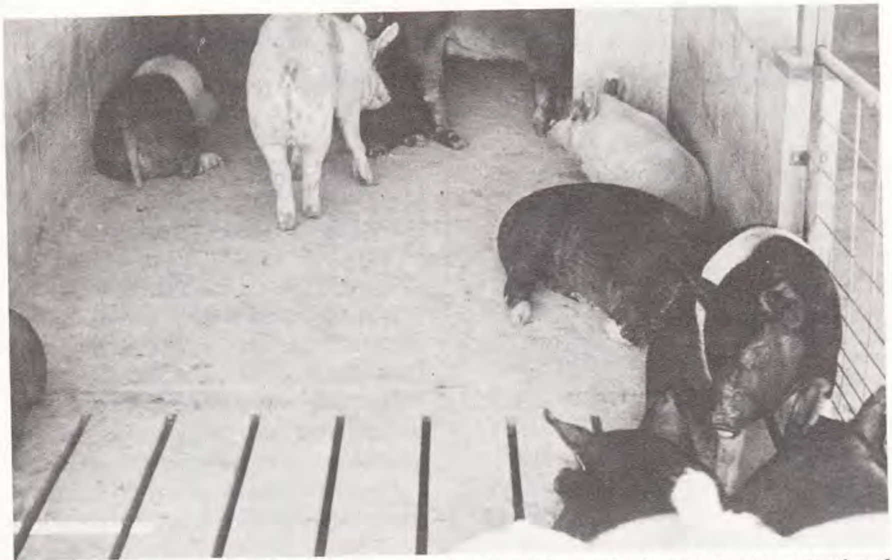
Pigs not wormed gained as well or better than those wormed. In fact, only those wormed with Atgard gained as well as the controls. For some reason, pigs wormed with Tramisol and Banminth gained 4% and 9% less, respectively, than the unwormed pigs.

Atgard and Tramisol wormed pigs showed a 6% and 11% improvement in feed conversion, respectively, over the controls. Besides the desire to rid our swine of parasites, the savings in feed from worming pigs with at least two of the wormers evaluated would probably more than pay for itself.

As you can see from worm count data in Table 1, pigs raised on slatted floors do build up parasite loads in their bodies. The untreated controls showed a marked increase in eggs/gram of feces over the entire experiment. The count also increased in the pigs that were wormed but certainly at a much reduced level. However, none of the egg counts were particularly high which might suggest that the parasite burden may be reduced in pigs raised on slats compared to those raised on pasture or dry lot.

In the past, condemnations of livers of pigs reared in the research unit used in this study have been great. It was felt that migrating parasite larvae damaged the livers and resulted in the condemnations. It would appear that there were more lesions in the livers from pigs not wormed compared to those wormed. The lowest number of lesions resulted from worming with Atgard.

To worm or not to worm pigs reared in confinement on slatted floors is the question. It appears that the answer is "to worm."



Eight-inch-wide slats with a smooth surface and pencil-round edge. Note the exceptional cleanliness of the sleeping area as well as the slotted area.

Effect of Slat Width and Type

Claw Lesions in Confinement

R. D. Fritschen
District Extension Specialist
(Animal Science)

The anatomy of the claw is probably the major factor leading to claw lesions in confinement.[1] The range of tissue types comprising the surface of the foot may be compared to an attempt to bond concrete and sponge rubber.

When the pig walks on soil, both the soil and the tissue yield on impact. To the pig walking on nearly all types of confinement surfaces only the tissue in the claw can yield. Since much of this tissue lacks or is limited in elasticity, tissue damage results. Subsequent bacterial infection is nearly immediate because of the continuous contact of claw and floor.

Studies from this Station in the past have shown the effect of various types of slat material on claw lesions. To gain a basis for reference the claws of pigs reared on soil were also studied. Those earlier studies, with some variation, indicate that rearing pigs on any artificial, nonresilient floor will result in more claw lesions than rearing them on soil.

In the 1975 Nebraska Swine Report it was reported that floors of 50% plastic slats with the balance of the floor solid concrete with a smooth surface, resulted in fewer and less severe claw lesions than steel, aluminum, or even 100% plastic slotted floors.

The Search for the "Best" Slat

In 1974 new concrete slats were designed and constructed for use in these studies. The new concrete slats were eight inches wide and had a smooth steel-troweled finish and a pencil-round edge. The edges were rounded with a ¼ inch sidewalk edger while the cement was still wet in the forms.

Forty pigs were allotted based on weight and sex to pens that were 50% slotted with either the eight-inch wide concrete slats or five-inch wide plastic slats. The remaining half of the floors were solid concrete with a smooth steel troweled finish. The pigs remained in their assigned pens for 123 days.

---

[1]The nation's pork producers have identified feet and leg problems as a major problem. This project is supported in part by a National Pork Producers Council grant.

Table 1. Effect of slat width or type on claw lesion level.

	Right Fore		Left Fore		Right Hind		Left Hind		
Type of slat	Outside	Inside	Inside	Outside	Outside	Inside	Inside	Outside	Avg.
8″ wide concrete[a]	2.6	2.7	2.2	2.6	2.6	2.2	2.5	3.1	2.6[c]
5″ wide plastic[b]	3.9	3.1	3.6	3.7	4.0	2.6	2.9	3.8	3.4
Avg.	3.2	2.9	2.9	3.2	3.3	2.4	2.7	3.4	

[a]18 total pigs, two replicate pens. Two pigs were removed for reasons unrelated to treatment effect.

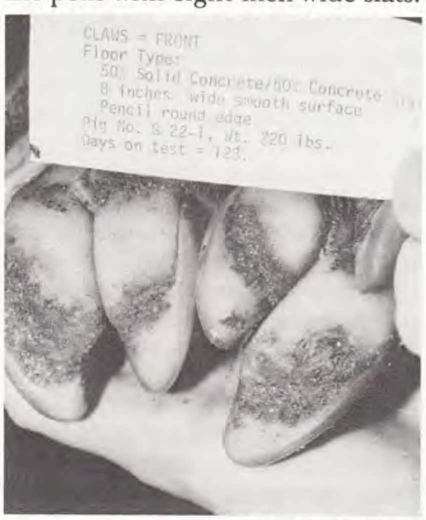
[b]20 total pigs, two replicate pens.

[c]The greater the value, the greater the degree of injury. Scoring system 1 to 6.

Claws were examined at an average pig weight of 196 pounds. The six category scoring system was used. In this system the greater the value or number, the greater the degree of injury. The pigs were mechanically lifted from the floor, their claws scrubbed clean with a soap solution, and scored. Table 1 summarizes scoring results.

Pigs reared on the eight-inch wide concrete slats with the smooth surface and the pencil-round edge had a much lower claw injury level and score (2.6 versus 3.4) than the pigs reared on five-inch wide plastic slats. Since width of slats as well as slat material is involved in this comparison it cannot be determined if the more desirable claw condition on concrete slats is due to design features or width alone.

It is obvious that there are more linear inches of slat edge in the pens with five-inch wide slats than the pens with eight-inch wide slats.



Average injury score for all four claws was 2.2. Note larger outside claws and wear on the tissue at the sole-toe junction (darker area).

Actual measurements show that there are 2790 linear inches of slat edge in the pens with eight-inch wide slats. There are 4410 linear inches of edge in the pens with five-inch wide slats. The implication of amount of slat edge in claw injury expression helps to explain why pigs on 100% plastic slats had more severe lesions than pigs on 50% plastic slats in last year's report. Until further studies are completed it should be assumed that slat width is as much a factor in reducing claw lesions as design feature or material.

Claws were not measured in this study. In previous studies claws were measured as well as scored. All previous studies showed that outside claws are larger than inside claws. In this study the average injury score for both fore and hind claws is greater on the outside members than the inside. This is more readily apparent when the scores for all outside and inside claws are averaged in Table 2.

Information in Table 3 shows that pigs reared on concrete slats had fewer lesions that those reared on plastic slats. Data in Table 1 are based on the single greatest lesion rather than total lesions even though more than one lesion may have been present on a claw. The magnitude of differences in Tables 1 and 3 are not quite the same. However, when information in the two tables is considered together it does show that the pigs on plastic

Table 2. Effect of slat width or type on average outside or inside claw injury score.

Type of slat	Outside claws	Inside claws
8″ wide concrete	2.7	2.4
5″ wide plastic	3.8	3.1

Table 3. Effect of slat width or type on claw lesion frequency.

Type of slat	No. of Lesions per pig[a]	No. of Lesions per claw[b]
8″ wide concrete	10.2	1.3
5″ wide plastic	12.4	1.6

[a]Total lesions for eight claws.

[b]Total lesions ÷ eight.

slats had more lesions and more severe lesions.

Summary

It is difficult to pinpoint the exact reason for the differences shown in this study. However, pigs on the eight-inch wide, smooth surfaced concrete slats with pencil-round edges had fewer and less severe claw lesions than pigs reared on five-inch wide plastic slats. It seems that desirable features of the concrete slats include:

1. Smooth steel troweled surface.
2. Pencil-round edge.
3. Wider slats provide fewer linear inches of slat edge.

The eight-inch wide slats were spaced one inch apart. Observations showed that they cleaned well. It was also observed that pigs on the wide concrete slats were much more mobile than those on plastic slats. Plastic slats appear to be quite slick for pigs, especially from about 120 pounds to market weight. This same observation on plastic slat slickness was made in last year's swine report and also by workers at other stations.

Average injury score for all four claws was 3.5. Note lacerations in the heel-sole area and extreme wearing of tissue at the sole-toe juntion.

Probiotics and the Newborn Pig

Murray Danielson
Associate Professor

Probiotics are microbial cultures orally administered to pigs. Their manufacturers anticipate that these organisms will play a beneficial role by controlling and balancing the microorganisms in the digestive tract. Recent research has identified several microorganisms called probiotics which are effective in controlling the numbers of other organisms.

None of us can deny that there are areas in livestock production that sometimes need a shot in the arm to overcome some type of stress. Antibiotics are widely accepted and play an important role in pork production. However, antibiotics have limitations. Possibly probiotics can fill this void in overcoming stress by promoting a more favorable microorganism balance in the digestive tract.

Newborn Pig Trials

This report deals with the use of probiotics in the newborn pig. The first trial was conducted with pigs born in a modern farrowing house.

The second trial was conducted with pigs born in outside individual farrowing houses under field conditions. In other respects, management of the two groups was comparable.

At about 12 hours after parturition (both trials) half of the boars and half of the gilts in each litter were orally dosed individually with 2 cc. of Probios, a commercial probiotic product. The treated pigs were given a second 2 cc. dose 12 hours after the first administration. The untreated pigs in each litter were considered control pigs. Number of pigs born alive (NBA), birth weight (BW), number of pigs at 7, 14 and 21 (N7, N14, and N21), weight of pigs at 7, 14 and 21 days (W7, W14, and W21) and percent survival rate appear in Table 1. Table 2 indicates the performance of the pigs whose birth weight was 2.5 lb or less.

From data in Table 1, the average individual birth weight as shown for group one is essentially the same for both the control and treated pigs. What little difference did exist prevailed at the end of the 21-day period. The 21-day weights of the treated group were slightly smaller than the control group (11.91 vs 11.42 lb). The treated group had a slight advantage in survival rate of 92 vs 82%. This small difference could easily have happened by chance.

Table 1. Pig performance (21 days).

	NBA	BW	N7	W7	N14	W14	N21	W21	Survival Rate
Group I (confinement)									
Control	50	2.76	41	5.28	41	8.69	41	11.91	82%
Treated	48	2.72	46	5.07	44	8.08	44	11.42	92%
Group II (Field)									
Control	74	3.30	67[a]	5.43	58[b]	8.68	54[c]	12.65	73%
Treated	77	3.26	63[b]	5.20	55[d]	8.40	55	12.22	71%

[a]Coyotes killed seven pigs.
[b]Coyotes killed nine pigs.
[c]Coyotes killed four pigs.
[d]Coyotes killed six pigs.

Table 2. Pig performance (only pigs with birth weight 2.5 lb and under).

	NBA	BW	N7	W7	N14	W14	N21	W21	Survival Rate
Group I (confinement)									
Control	16	2.18	11	4.49	11	7.63	11	10.95	69%
Treated	21	2.10	19	3.75	18	7.12	18	9.96	86%
Group II (Field)									
Control	14	2.17	12[a]	3.25	9[b]	5.70	9	8.92	64%
Treated	14	2.19	11[b]	3.21	7[c]	5.40	7	8.27	50%

[a]Coyotes killed one pig.
[b]Coyotes killed two pigs.
[c]Coyotes killed three pigs.

No Response found

Data in Table 1 for pigs farrowed under field conditions were consistent with the performance of the confinement pigs. There was no difference in the survival rate (73 vs 71%).

Table 2 shows the performance of pigs weighing 2.5 lb or less at birth. The treatment trends for the small birth weight pigs were similar to the group as a whole.

These data indicate no definite response to the probiotic. The field study was conducted during the summer season which in this area provides a very favorable environment for producing pigs. The small differences in confinement leads one to speculate that there might be some hidden stresses in confinement which the probiotic tended to help overcome.

Market Hogs— What Weight?

W. T. Ahlschwede
Extension Livestock Specialist (Swine)

The pork industry appears to have an opportunity to reduce production costs by increasing weight of market hogs. Under most conditions producers can reduce production costs by carrying hogs to heavier weights. Packers can reduce per pound processing costs by slaughtering heavier hogs. To realize these apparent advantages, major changes must be made. Leaner pigs will be required. Processing and merchandizing methods will need revision.

Pork producers determine the weight of their market hogs by choosing when to sell them. The decision to sell may be based on many factors. In addition to selling pigs because they are ready, producers may choose to sell or delay selling based on the pressure of field work, anticipated price changes, overcrowding of facilities, high feed costs, bad weather, tax considerations, or the need to pay bills. While based on many factors, the choice of when to sell effects both the quantity of pork on the market as well as carcass quality. The choice of when to sell may also influence production costs and the price received.

Quantity

The volume of product can be varied considerably by selling sooner (lighter) or later (heavier). Marketing 240 lb hogs a week later represents a 6% increase in volume. Selling a week sooner would cause a similar 6% reduction in volume. Industry wide, such a change could have a marked effect on the pork supply. In the long run, changes in market hog weight can help correct both oversupply and undersupply and more evenly meet consumer demand. In the short run, this type of change in market weight can interrupt the orderly flow of pork to market and cause exaggerated fluctuations in the prices paid for hogs.

Quality of Product

Pork producers have made dramatic changes in carcass leanness of pigs. Since the introduction of the meat-type hog in the mid-1950's, market hogs have become meatier annually. This increased leanness has had two favorable effects. The first and most direct effect is the reduction in fat or lard produced per pig. Since lard generally sells for ⅓ to ¼ the price of the lean cuts a shift in carcass composition to less fat or lard makes each hog more valuable. Secondly, consumers hold this "new pork" in higher esteem. As the retail product has become less fat, consumers have been willing to buy pork more consistently. These two factors taken together may explain why pork production has been the most consistently profitable livestock enterprise over the last 10 years.

What does that have to do with market hog weight? Very simply, hogs get fatter as they get bigger. A study reported by Iowa State University in 1975 shows this change in carcass composition. As the slaughter weight increased, the percent fat of the carcass increased. The fat percent increase was small as hog weight changed from 200 lb to 230 lb. When hog weight changed from 230 to 260 lb, the increase was dramatically large. The change was the same for both "fat line" and "lean line" pigs. If one considers the carcass weight change, from the 230 lb to the 260 lb slaughter weight, 74% of the added carcass weight was fat in the lean line. In the fat line, 81% of the change was fat. Clearly, the added weight reduced the meatiness of the pigs.

The Iowa study also points out the superior quality of leaner pigs. The lean pigs were as lean at 260 as the fat pigs were at 200. Further, the lean pigs were superior to the fat pigs at each weight. This change in carcass leanness has allowed producers to market acceptable hogs at heavier weights.

Production Costs

In the short run, the production costs of interest in deciding to take pigs to a heavier weight are the costs of putting on the extra weight. These costs are primarily feed costs. Non-feed costs for extending the finishing period are about 5¢ per day and are small compared to the feed cost. Evaluation of the feed cost for the added gain involves several factors. Farm-to-farm management practices, seasonal temperature differences, facilities, diet formulation, diet cost and pig weight must all be considered. Even though many of these factors vary from group of pigs to group of pigs, the relationship between pig weight and feed efficiency appears to be fairly constant.

(continued on next page)

What Weight?

(continued from page 9)

Numerous research reports consistently indicate that the amount of feed required per pound of gain increases as the weight of the pig increases. This relationship is shown in Table 1. The feed efficiency figure indicates the amount of feed required for the next pound of gain. The figures in Table 1 are based on more than 20 research reports. The feed efficiency figures have been adjusted to reflect production rather than research conditions. The feed costs assume a diet cost of 6¢ per pound. The non-feed costs assume 2 lb per day gain.

In the long run (over several production cycles) marketing market hogs at heavier weights provides an opportunity to reduce per pound production costs by spreading feeder pig costs over more pounds of gain. In units which farrow, the sow feed and farrowing costs are prorated over more pounds marketed per sow unit. In these units, marketing at heavier weights reduces the portion of the income which is attributable to the skilled labor inputs during the breeding and farrowing period. Marketing at heavier weights lengthens the finishing period and reduces the number of pigs which can be produced in a given facility. Producers who are making full use of their facilities may not be able to increase market weights without major facility changes.

Price

The price received for market hogs varies. Average market hog price changes from day to day, week to week and year to year. The price also varies with the weight of the hog. Generally, packers buying hogs in Nebraska pay more for pigs weighing between 210 and 230 pounds.

The preferred weight range and the discounts for lighter or heavier weights change daily with the hog supply and packer need. On days when hogs are in short supply, packers may pay top prices for all weights. On days when the supply of hogs is large, weight discounts may be increased. Given a reasonable supply of hogs, the weight discounts for heavier weight hogs represents decreased product value for heavier carcasses. Heavier hogs have heavier hams. Heavier hams generally have less value per pound on the wholesale market than lighter hams. Packers occasionally bid up heavy hogs to fill prior contract commitments.

Table 1. Cost of gain at market weights.

Pig Wt.	Feed/gain	Feed cost	Non-feed	Total
200	4.53	$.272	$.025	$.297
210	4.60	.276	.025	.301
220	4.68	.281	.025	.306
230	4.77	.286	.025	.311
240	4.83	.290	.025	.315
250	4.92	.295	.025	.320
260	5.00	.300	.025	.325

Examples of the weight-price relationship are given in Table 2. These examples represent two buyers, one on a given day in mid-October, the other in mid-November. They were typical of the markets on those days. Traditionally, this type of weight-price relationship has existed, but is subject to daily changes. This relationship also varies with the weight of the hogs on the market. As the percentage of hogs over 250 lb on the market increases, the weight discount also tends to increase.

Price Changes

Few producers have been able to accurately predict market price changes. While the production cost for the added weight can be considered separately from total production costs, changes in price affect the total pig weight, not just the price received for the added weight. Many producers have been disappointed when the market dropped just when they had decided to delay marketing a group of pigs. Others of course have profited by holding when the price continued to rise.

Table 2. Weight discounts.

Weight	Hormel Mid-October	Farmland Mid-November
200-230 lb	Base	Base
230-240 lb	$.25/cwt.	$.25/cwt.
240-250 lb	.50/cwt.	.75/cwt.
250-260 lb	1.00/cwt.	1.50/cwt.
260-270 lb	1.50/cwt.	2.25/cwt.
270-280 lb	2.00/cwt.	4.00/cwt.

One prevailing philosophy regarding the weight to market hogs is, "Sell hogs at heavier weights on an increasing market and at lighter weights on declining markets." While this marketing strategy seems logical and promises producers increased profits, it may disrupt the market. Selling hogs at heavier weights requires that marketings be delayed. This holding of hogs off the market reduces supply and causes further increases in market price. When the hogs are then marketed at the heavier weight, supply is increased and quality decreased. These two factors in addition to the heavier cut weights cause the market to fall. Consequently, those who hold their pigs on the rising market often sell them for less. This particular marketing strategy tends to disrupt the market and causes instability in both the volume of pork sold and in the prices received by all producers.

Changes for Heavier Weights

There are two dimensions to the consideration of appropriate market hog weights. One is the short run decision producers make daily in selling or not selling their market hogs. Producers profit or lose individually based on the wisdom of their choice. Taken together, their collective decision affects the response of the market to their decision. Choice of market hog sale weights reflects an industry-wide marketing strategy.

In the long run, the pork industry has an opportunity to reduce costs by increasing market weights. If succeeding crops of pigs become leaner, they can be marketed at increasing weights while maintaining an acceptable carcass composition. To profitably move larger carcasses to the consumer, packers, processors and retailers will have to institute processing and merchandising procedures which will maintain or improve pork's consumer acceptability. Only if these two segments of the industry make the needed changes will the industry profit by moving to heavier weights.

Growing-Finishing Diets

Corn, Wheat, Alfalfa

Murray Danielson
Associate Professor (Swine)

Previous work at the North Platte Station has indicated corn-soy growing-finishing diets containing 25% alfalfa hay support acceptable pig performance. These studies involved corn as the source of grain. The intent of this study was to utilize corn, wheat and alfalfa hay in various combinations when formulating a growing-finishing diet.

One-hundred-eighty crossbred pigs initially averaging 24-25 lb were randomly assigned to 10 diet treatments. Sex was uniformly distributed within each pen of six animals. Three pens were assigned to each of the experimental diets. Housing and management were comparable for all pigs in this study. The pelleted diets and water were available *ad libitum* for the duration of the 126 day trial. The individual diet formulations appear in Table 1.

The first eight diets were formulated on the basis of a 16% protein diet. Diet 9 is the same as diet 1 except that wheat replaced corn pound for pound. Diet 10 is comparable to diet 1 with the exception that about 50% of the corn was replaced with alfalfa and the remaining corn replaced with wheat. The origin or variety of the wheat is unknown as it was purchased from a local elevator. The protein content of the wheat analyzed 12.38%. Average daily gain and feed conversion (pounds of feed required per pound of gain) were the criteria used to measure pig response to the respective diet treatments. Performance figures appear in Table 2.

Average daily gain of the pigs on diet 2 (all wheat) was one of the lowest of any of the treatments included in this study. However, feed conversion was among the best. Pigs on this diet were reluctant from the start to accept this diet and thus their intake was limited. Other researchers have reported palatability problems with all-wheat diets. Palatability possibly was a factor with this diet.

Table 1. Composition of diets (percent).

Ingredient	Diets 1	2	3	4	5
Corn	73.55	—	—	—	30.00
Wheat	—	82.50	65.00	45.00	30.00
Alfalfa hay	2.50	2.50	25.00	45.00	25.00
Soybean meal (44%)	20.50	11.25	7.50	7.3375	12.50
Calcium carbonate	1.01	1.175	0.425	0.2125	0.36
Cyphos[a]	1.00	0.63	0.79	0.70	0.95
Salt (iodized)	0.50	0.50	0.50	0.50	0.50
Trace minerals[b]	0.075	0.075	0.075	0.075	0.075
Vitamin premix[c]	0.865	1.37	0.71	1.175	0.615
Chemical analysis:					
Protein	15.56	15.35	15.38	16.04	15.92
Calcium	0.71	0.67	0.70	0.76	0.73
Phosphorus	0.51	0.49	0.49	0.49	0.51

Ingredient	Diets 6	7	8	9	10
Corn	38.75	28.50	21.25	—	—
Wheat	38.75	28.50	43.00	73.55	38.025
Alfalfa hay	2.50	28.50	21.25	2.50	38.025
Soybean meal (44%)	16.50	11.50	11.50	20.50	20.50
Calcium carbonate	1.09	—	0.50	1.01	1.01
Cyphos[a]	0.815	1.49	0.865	1.00	1.00
Salt (iodized)	0.50	0.50	0.50	0.50	0.50
Trace minerals[b]	0.075	0.075	0.075	0.075	0.075
Vitamin premix[c]	1.020	0.935	1.06	0.865	0.865
Chemical analysis:					
Protein	15.69	15.59	15.77	18.61	19.96
Calcium	0.70	0.50	0.72	0.73	1.22
Phosphorus	0.52	0.68	0.51	0.59	0.56

[a]Contains 18.5% phosphorus and 18.0% calcium.

[b]Calcium Carbonate Company, swine, 20% zinc.

[c]Contributed the following per pound of complete diet: Vitamin A, 1500 IU; Vitamin D, 202 IU; Riboflavin, 1 mg; Niacin 0.5 mg; Calcium pantothenate, 4.5 mg; Choline chloride, 100 mg; and Vitamin B_{12}, 10 mcg.

[d]Inadvertently used monosodium phosphate in place of cyphos for entirety of study.

Pigs fed diet 4 had the lowest average daily gain along with one of the poorer feed conversions. The diet was formulated with rather high quantities of wheat and alfalfa and contained the smallest amount of soybean meal. The high crude fiber content along with the possible inadequate lysine content may have been responsible for the poor performance.

Table 2. Pig measurements (126 days).

Diet No.	Initial wt., lb.	Average daily gains, lb.	Feed conversion	Termination wt., lb.
1	24.5	1.66	3.23	234.4
2	24.3	1.38	3.25	198.3
3	24.5	1.54	3.35	218.5
4	24.7	1.35	3.89	194.4
5	24.6	1.62	3.59	228.7
6	24.1	1.53	3.23	217.4
7	24.7	1.52	3.59	215.9
8	24.8	1.58	3.30	224.0
9	24.4	1.59	3.02	224.7
10	24.7	1.49	4.03	212.5

Average daily gain of the pigs on the remaining diets varied from 1.66 lb for diet 1 to 1.49 lb for diet 10. All are respectable gains. The feed conversion figures were within a respectable range with the exception of diet 10. Diet 10 was formulated with equal quantities of wheat and alfalfa. It was similar to diet 4 except that it contained more than twice as much soybean meal. Both diets 4 and 10 tended toward excess feed wastage which contributed to less desirable feed conversions. The increased soybean meal content of diet 10 over diet 4 appeared to contribute to an improved average daily gain.

The results of this study indicate that alfalfa hay can be effectively used in formulating diets in combination with corn and/or wheat for growing-finishing pigs. The 25% level of alfalfa hay appeared to be the upper limit with either corn or wheat in this study for both respectable average daily gain and feed conversion figures.

Early Puberty

Effect of Transport Phenomenon, Boar Contact

Dwane R. Zimmerman
Professor, Swine Physiology

Early puberty is important to maximizing litter size potential of gilts. Ovulation rate (number of eggs produced) and litter size both increase with the number of heat periods expressed by gilts prior to breeding (Figure 1). Reducing age at puberty (onset of first heat) to 6-6½ months would increase litter size at breeding (7-9 months of age) without increasing production costs and would materially improve the productive efficiency of the breeding herd.

The rearing of gilts in confinement appears to delay puberty and/or interfere with the expression of estrus associated with the first ovulation. The causes of this reproductive failure are obscure but many swine producers have been able to overcome this problem by moving the gilts outside before breeding. What aspects of the change in environment are essential for the response and how these factors are able to trigger puberty remain largely unexplained. However, two associated factors, the "transport phenomenon" and boar contact play major roles in the response.

The Transport Phenomenon

"Transport stress" was first reported to trigger a synchronous first estrus in gilts nearing the age of puberty (90-110 kg weight). French scientists obtained a 22% estrous response 4-6 days after the gilts purchased from multiple sources in the country were transported to the research station. They examined the possibility that the response might be due to contact with a boar, but concluded that the response was due to the stress of transport rather than the "male effect."

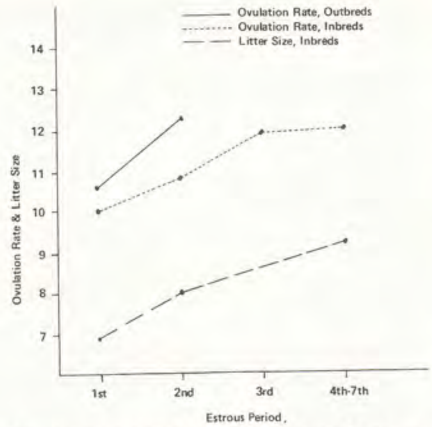


Figure 1. Relationship of sexual age to ovulation rate and litter size.

Gilts reared on pasture and delayed in attaining puberty respond to a change in location and contact with unfamiliar gilts. In a controlled experiment conducted at the University of Nebraska to determine what aspects of the "transport phenomenon" are of primary importance, gilts were assigned to four treatments at 165 days of age. Gilts were either (1) mixed with unfamiliar gilts but left at the original location (M), (2) mixed with unfamiliar gilts, transported (T) 1½-2 miles by trailer and then returned to the original pen location (M&T), (3) mixed with unfamiliar gilts, transported and relocated (R) in pens at a different location (M, T & R) or (4) mixed with unfamiliar gilts, transported, relocated and exposed to a boar (M, T, R & BE).

The mixing of unfamiliar gilts alone or combined with actual transport failed to trigger a synchronized first estrus but relocation to different pens in addition to M and T produced a 28% ovulation response during the following 10 day period (Table 1). The actual transport employed represents a much milder form of transport than was used by the French workers. This may account for its relative ineffectiveness in this experiment. Relocation to different pens, however, seemed to be the important component of the "transport phenomenon."

Table 1. Influence of various stimuli on pubertal response.[a]

Treatment[b]	Estrus	(%)
Mixed only (M)	2/26	7.7
M & transported (T)	2/24	8.3
M, T & relocated (R)	7/25	28.0
M, T, R & boar exposed[c]	20/23	86.9

[a]Based on a 10-day response period following initiation of treatment.

[b]All treatments initiated at approximately 165 days.

[c]Continuous contact with a boar for 10 days.

Boar Effect

Providing gilts continuous contact with a boar was by far the most effective stimulus for triggering puberty in the experiment described above. Eighty-seven percent of the gilts exposed to the boar in addition to being subjected to the "transport phenomenon" expressed first ovulation within 10 days as compared to 28% of the gilts subjected to the "transport phenomenon" only. These findings confirmed the results of previous experiments at the University of Nebraska which had demonstrated that isolation of gilts from the boar markedly delayed puberty (Table 2).

Once-daily contact with a boar initiated at 125 days induced puberty 32 days earlier in one experiment and 24 days earlier in a second experiment compared to control gilts isolated from the boar. The effect appeared to be specific for the boar since the isolated control gilts in the second experiment failed to respond to an ovariectomized gilt introduced once daily starting at 125 days. Attempts are now being made to learn what stimuli from the boar (odor, sound, touch or visual stimuli) are the most important for inducing the estrous response in gilts.

Synchrony Effect

The boar not only causes earlier

Table 2. Effect of boar exposure on age at puberty (days).

Year	Boar exposed[a]	Isolated[b]
1968	157	189
1972	186	210[c]

[a]Once-daily boar exposure initiated at 125 days.

[b]Isolated from the boar but observed once daily for estrus starting at 125 days.

[c]Received contact with an ovariectomized gilt starting at 125 days.

puberty but tends to induce a synchronous first estrus if contact with him is delayed until gilts are nearing pubertal age. The English workers (Brooks and Cole, 1970) observed a 91.7% estrous response in 5 days and a 90% estrous response in 10 days following initiation of boar contact at 165 and 190 days, respectively. This compares favorably with the 87% synchrony response described above (Table 1) and with the results of other University of Nebraska experiments. Exposure of gilts to the boar at younger ages (125-155 days) has produced earlier puberty than boar exposure later (165-195 days). More synchrony was observed when boar contact has been withheld until after 165 days. All of this research has been done outside in drylot with crossbred gilts that generally average between 175 and 185 days at puberty.

Summary

Results indicate that earlier puberty can be induced in gilts by exposing them to a boar during development. Early boar exposure will produce a greater overall reduction in average age at first estrus than late exposure but late boar exposure will trigger a more synchronized first estrus. What is considered early or late will depend on the pubertal age typical for the breeding and management of the gilts to be treated.

The "transport phenomenon" appears to be less effective than the boar but has been shown to trigger a synchronized first estrus in gilts nearing puberty or delayed in reaching puberty. From University of Nebraska data, the key aspect of the "transport phenomenon" appears to be the change in location rather than the change in social group or the actual transport. Much greater understanding is needed regarding the "transport effect" and the "boar effect" before solid recommendations can be made in terms of how best to utilize these effects to induce earlier puberty and whether these stimuli are equally effective under both pasture and confinement systems of management.

Protein Levels For the Developing Boar

Bobby D. Moser
Assistant Professor, Swine Nutrition

Keith Gilster
Extension Specialist
(Swine Nutrition)

The protein requirement for market hogs has been well established. Information concerning the protein requirement of the growing and developing boar is, however, somewhat limited. Knowledge of the specific protein requirement of boars is desirable in view of the increased interest in boar evaluation in central testing stations and on-the-farm testing programs.

What is the optimum protein level for growing and developing boars? Cunningham *et al.* (1973) at Nebraska observed that growing boars require no less than 14% protein as indicated by a reduced average daily gain and increased backfat probe when boars were fed a 10% protein diet. Information from the Northeast Iowa Swine Testing Station fall test (1971) in-

(continued on next page)

Table 1. Protein levels for boars[a] (Nebraska Experiment 74416).

	Growing		Finishing			Growing-Finishing			
Protein level (%)	18	16	18	16	14	18–18	18–16	16–16	16–14
Daily gain, lb									
68-135	1.98[b]	1.99	—	—	—	—	—	—	—
135-230	—	—	2.28	2.32	2.22	—	—	—	—
68-230	—	—	—	—	—	2.17	2.14	2.21	2.06
Feed intake, lb									
68-135	4.11	4.26	—	—	—	—	—	—	—
135-230	—	—	5.94	6.24	6.14	—	—	—	—
68-230	—	—	—	—	—	5.24	5.20	5.25	5.10
Feed/gain									
68-135	2.11[c]	2.12	—	—	—	—	—	—	—
135-230	—	—	2.69	2.58	2.72	—	—	—	—
68-230	—	—	—	—	—	2.42	2.44	2.34	2.48
Adj. probe in 220 lb	—	—	—	—	—	0.97	0.94	0.96	0.99

[a]Appreciation is extended to Waldo Farms, DeWitt, Nebraska, for supplying the boars, facilities and feed in the conduct of this experiment.

[b]Least square means.

[c]All diets were pelleted.

Protein Levels . . .

(continued from page 13)

dicated that boars will routinely gain faster than barrows. In the above study from Nebraska, barrows gained faster than the boars when both were fed the 14% diet. This would suggest that the 14% diet was adequate for the barrows, but inadequate for the boars. Therefore, protein levels normally fed to market hogs may not be adequate for boars.

Facilities (pasture vs concrete) could have an effect on the protein level necessary for boars. In an early study, Speer *et al.* (1957) at Iowa found that boars required at least 16% protein on concrete while 13% appeared to be adequate on fresh alfalfa pasture. Thus boars can utilize some protein from fresh alfalfa pasture.

Performance

To further refine the protein requirements of the boar, a study was conducted to determine the effect of protein level on performance and backfat probe of growing and developing boars. In this study, 100 Duroc boars from the Waldo Duroc Farm, DeWitt, Nebraska, were assigned to four treatments: (1) 18% protein, (2) 18% protein to 135 lb, then 16%, (3) 16% protein, (4) 16% protein to 135 lb, then 14%. The boars were started on test at an average weight of about 68 lb and taken off test and probed at approximately 230 lb (Table 1). During the growing phase (68–135 lb), average daily gain and feed conversion was almost identical for boars fed the 18% and 16% protein diets. During the finishing phase, boars fed the 16% protein diet produced the fastest and most efficient gains. The 14% diet produced the slowest and least efficient gains and there was no advantage to feeding an 18% protein diet during this phase. When both the growing and finishing phases were considered, boars fed the 16-16% protein regime produced the fastest and most efficient gains. Protein level had little effect on backfat probe. Boars fed the 14% diet were slightly fatter. Boars were scored for soundness. There was no significant difference in soundness score due to dietary protein level.

Table 2. Suggested protein levels for the boar: optimum gain, feed efficiency and muscle development.

	Protein level (%)[a]
Weaning – 70 lb	18
70 – 250 lb	16
250 lb – Breeding boar	14

[a]Corn-soybean meal diet and concrete or dry lot pens.

In general, for all phases, there was little difference in the performance and backfat probe of pigs fed the 18 and 16% protein diets, but the 14% diet produced the slowest and least efficient gains with the highest backfat probe adjusted to 220 lbs.

Conclusion

Results of this study indicate that a 16% protein diet supports maximum growth, efficiency and muscular development for young boars between 70 and 250 pounds. For optimum performance, it is suggested that young boars be fed an 18% protein diet between weaning and 70 lb, a 16% diet between 70 lb and the end of the test and a 14% diet after the test is completed. Simple corn-soybean diets fortified with vitamins and minerals are recommended.

Reovirus-like Agent in Pig Scours

Norman R. Underdahl
Professor, Swine Diseases

Charles A. Mebus
Professor, Pathology

Recently, a reovirus-like agent has been reported to be a cause of baby pig scours. It appears this agent has counterparts which can infect a wide range of hosts.

In 1969, a reovirus-like agent was found to be the major cause of diarrhea in baby calves. Since then, a vaccine has been developed which prevents the infection with the virulent reovirus-like agent. Reovirus-like agents have also been reported to infect human infants, monkeys, mice, horses, and sheep. These agents all infect the intestinal tract of the respective host and cause diarrhea and dehydration. The viruses are all related antigenically and in serological tests will cross-react. The human reovirus-like agent will multiply in the intestine of both the calf and the baby pig and the pig has been used as an experimental model to study the human reovirus-like agent.

Reovirus-like agent infection in pigs is difficult to differentiate from transmissible gastroenteritis. Reovirus-like agent infection is generally found in pigs one to five weeks of age and clinically resembles a mild form of TGE.

Death Rate High

In reovirus-like infection, the pigs first develop a yellow milky-diarrhea which becomes more liquid in two to four days. The death rate may be around 15-20%, but has been reported higher. In some cases, the secondary bacterial agents may be responsible for the higher death rate as has been reported for calf diarrhea caused by the reovirus-like agent.

In nursing pigs, TGE is more explosive and the morbidity usually approaches 100% (all pigs infected). Severe diarrhea with liquid stools begins 24-28 hours post-infection and sows may also show clinical signs of the disease. Vomition is generally seen in TGE infection prior to the onset of diarrhea.

In many cases of reovirus-like agent infection, the sows do not become sick but isolated incidences of sow illness and infection of feeder pigs have been reported. The infection of older pigs would indicate an initial infection of a herd. In TGE on initial infection, the sows, baby pigs and other pigs on the farm also generally become infected. In pigs nursing immune sows, the pigs will not become infected with TGE until weaning or near the end of the nursing period.

Causes Atrophy

The reovirus-like agent causes atrophy of the villi of the small intestine of the pig. Unlike TGE which causes severe villous atrophy in the entire small intestine (except the upper few inches of duodendum), the reovirus-like agent causes less damage to the villi and generally only effects villi in the lower one-third to two-thirds of the small intestine.

Intestinal cells infected with the reovirus-like agent will react with antibody to the calf reovirus-like agent; and when frozen sections of the infected pig intestine are treated with fluorescein-tagged antibody to the calf virus, immunofluorescence will develop (Fig. 1). This procedure can be used as a diagnostic test for identifying reovirus-like agent. The reovirus-like agent will not cross react with TGE-tagged antibody. The pig reovirus-like agent will also cross react with the antibody to human reovirus-like gastroenteritis agent. However, in some experiments, antibody to the pig reovirus-like agent did not react with the calf reovirus-like agent.

Reovirus-like agent diarrhea can also be confused with colibacillosis or pathogenic *E. coli* infection. In colibacillosis, fewer pigs generally

Figure 1. Fluorescent antibody to the calf reovirus-like agent staining the reovirus-like agent in the epithelial cells covering the villi taken from a germfree pig infected with virus obtained from field case.

Table 1. Comparison of transmissible gastroenteritis and reovirus-like agent in pigs.

	TGE	Reovirus-like agent
Incubation time	24-48 hours	2-4 days
Vomition	Preceding diarrhea	Rare
Diarrhea	Watery 24-48	Creamy changing to watery
Villous atrophy	Severe Entire small intestine	Less severe Lower ⅔ of small intestine affected
Fluorescence with tagged-calf antibody	No fluorescence	Good fluorescence
Clinical signs of sickness in sow	Yes	Generally—NO
Mortality	Nearly 100% in pigs under 10 days of age	10-20%

are involved and not all of the pigs in a litter or all of the litters in the farrowing will have clinical signs of illness.

It appears that in some herds with continuous farrowing, the reovirus-like agent can become enzootic to the herd and the pigs in each farrowing become infected when the antibody level in the milk becomes reduced. Treatment with antibiotics will not control the reovirus-like agent but antibiotics are beneficial in preventing secondary invaders. Pigs that recover generally return to normal growth and do well.

Reovirus-like agent and TGE have been found in the same herd. Under these conditions, it appears the reovirus-like agent and the TGE virus were both enzootic in the herd. The clinical signs of disease appeared near or at post-weaning, and the death-rate was comparatively low.

The virus, until recently, has resisted adaption to growing in cell culture, but researchers at South Dakota State University have now reported growing the virus in cell culture. If the Reovirus-like agent responds the same as the calf reovirus-like agent, then a suitable vaccine can be produced.

Adding Animal Fat . . .

G-F Swine Diets

Bobby D. Moser
Assistant Professor (Swine Nutrition)

Larry Bitney
Extension Economist (Farm Management)

In the 1975 Swine Report we reported a study in which adding 5% fat to growing-finishing diets produced a 7.5% improvement in average daily gain and a 13% improvement in feed conversion. This was during a period when the prices of conventional energy sources were at an all time high. Even though the price of feed grains are lower now they are still above the so-called "normal" price. Therefore a study was conducted to determine the optimum energy level for gain and feed conversion and the most economical and practical level to feed.

In this study 96 pigs weighing about 65 pounds were assigned to six levels of added dietary fat: 0, 2.6, 5.2, 8.0, 10.5 or 13.2% of the diet. The levels provide increases of 50 Kcal of metabolizable energy per pound with each increasing level of fat. The fat was fixed in the diets at the above levels and corn and soybean meal were balanced to give an equal protein (14%) and lysine (0.7%) level for all diets. All diets were fortified with vitamins and minerals. The trial was conducted during the winter (Feb. to May, 1975) in an MOF finishing building. The fat used in this study was fancy tallow which is commercially available.

Performance

As was true with the 1975 study, adding fat to growing-finishing

(continued on next page)

Adding Animal Fat

(continued from page 15)

swine diets increased average daily gain, decreased daily feed intake and improved feed conversion as compared to the control (0% added fat) (Table 1). Average daily gain increased as fat level increased, reaching a maximum gain (1.60 lb/day) at 9.0% added fat, then gradually decreased. Feed conversion was markedly improved with the first two levels of fat additions then tended to level off. Also, adding fat to growing-finishing diets as high as 13.0% did not drastically affect backfat thickness or ham-loin percentage. Adding tallow to a corn-soybean meal diet not only improves performance but also lowers the dustiness of the diet. This should lower the dustiness of the building.

Table 1. Fat addition for growing-finishing swine (Nebraska Experiment 75401[a]).

	Fat addition, %[b,c]					
	0	2.6	5.2	8.0	10.5	13.2
Initial wt., lb	65.2	65.1	65.4	65.2	65.1	65.2
Final wt., lb	203.7	207.0	210.1	214.6	213.7	209.0
Daily gain, lb.	1.56	1.61	1.65	1.69	1.68	1.63
Feed intake, lb.	5.58	5.30	5.14	5.04	5.01	4.76
Feed/Gain	3.58	3.30	3.12	2.98	2.98	2.92
Backfat, in.	1.50	1.34	1.40	1.45	1.42	1.48
Ham-Loin, %	42.0	42.0	42.5	41.2	41.2	41.4

[a]Winter study, Feb.–May, in a modified-open-front building.
[b]Diets were corn-SBM-14% protein.
[c]Fat added as Bleachable Fancy Tallow, courtesy of National By-Products, Inc., Bellevue, Nebr.

Economic Analysis

How do you decide whether to add fat to your swine finishing rations? If you decide to do it, how much do you add? To evaluate these questions, let's look at the costs, and the benefits.

When we add fat to a ton of swine feed, we take out some corn. Thus, the price relationship between corn and fat is important. Also, when fat is added, some additional protein supplement must also be added to offset the difference in the protein level between corn and the fat source. Diets containing fat will require less synthetic lysine than diets which contain corn as the only energy source. The comparative costs of these ingredients which are "shuffled" as increasing amounts of fat are added to a swine diet will determine the total cost per ton of the diet at each energy level.

What about the benefits? As shown earlier in this article, diets with higher energy levels (containing more fat) result in more efficient feed conversion — fewer pounds of diet per pound of gain. In addition, average daily gains may increase with higher energy levels. However, the increases in feed efficiency are more readily substantiated than the increases in average daily gains. Thus, only increases in feed efficiency will be considered as the "benefits" in this analysis.

The results of the substitution of feed ingredients, as well as the resulting changes in feed efficiency may be evaluated using Figure 1. The price of fat, laid in at your mixer, is read on the vertical axis. The price of corn per bushel is read on the horizontal axis. Draw a line upward from the corn price and to the right from the fat price. In Figure 1, we have done this, using a corn price of $2.50 per bushel and a fat price of 15 cents per pound. The dotted lines meet at "point a." This point is in a region of the chart which indicates that it is most economical to feed diets containing 5.2% fat (level 3).

The slanting lines in Figure 1 are break-even lines, indicating the points at which the level of fat on either side of the line would result in exactly the same diet cost per unit of gain. For example, if corn were $2.80 per bushel and fat were 15¢ per pound (point b in Figure 1), it would be a toss-up between level 3 (5.2% fat) and level 4 (8.0%). The "best" fat level at these prices would be some level between 5.2 and 8.0 percent.

Figure 1 may be used as a decision guide in selecting fat levels for swine diets. High corn prices tend to make higher fat levels more attractive, while lower corn prices produce the opposite result. Higher fat prices should cause selection of lower fat levels, while the reverse is true with low fat prices.

The cost of equipment for mixing diets containing fat has not been considered here, but should be small on a per ton basis. The

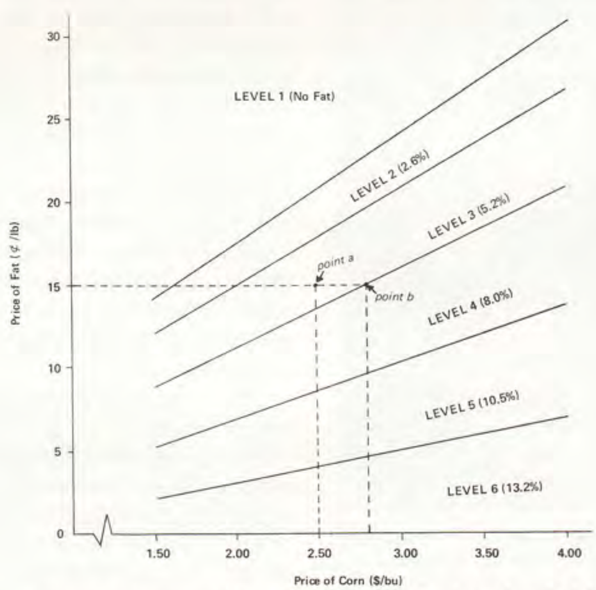


Figure 1. Suggested levels of fat addition in swine finishing rations at alternative fat and corn prices.

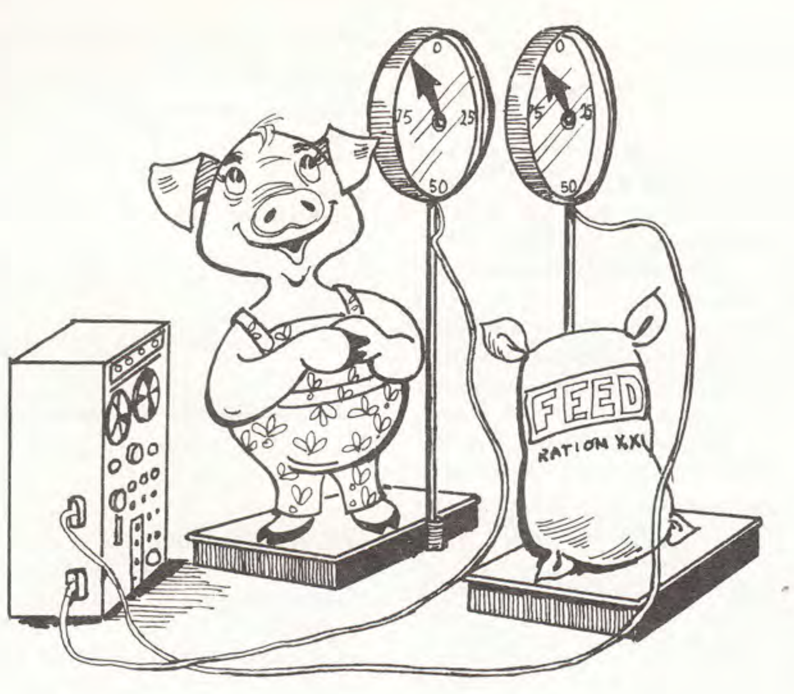
cost of soybean meal used in the analysis was $130 per ton. Variations in the soybean meal price around this figure will not change the structure of Figure 1 appreciably.

Management Consideration

There are several management considerations which must be considered when selecting the proper level of fat to feed. The fat that was used in this study was added in liquid form. This involved melting the tallow and adding it slowly to the diet while it is mixing. Adding it slowly is important since the feed will ball up if fat is added too rapidly. We also observed that feed would stick to the sides of the mixer with diets that contained fat levels above 8%. If the feed is sacked, plastic lined bags are recommended for diets containing 8% fat or more. Unlined paper bags tend to absorb some of the fat from the feed. Diets that contained 10.5 and 13.2% added fat tended to bridge in the feeders, especially during cold weather. Bridging was not a problem with diets that contained 8.0% fat or less in the wooden feeders we used. Storage of diets should not be a major problem if stablized fat is used. However, fat storage containers should be kept free from contamination by dust and other foreign material to assure a high quality product. Length of storage is a factor to consider, especially in warm temperatures. Diets with high levels of stablized fat should be stored no longer than four weeks in the winter and two weeks in the summer.

Summary

For 1976, it appears that with fat prices in the neighborhood of 15 cents per pound, and corn prices in the $2.30-$2.60 per bushel range, adding fat at about the 5% level will produce the most economical gain for growing-finishing hogs. However, as the price of animal fat and/or corn varies the level of fat added to the diet would also vary to produce the most economical gain. For physical handling purposes fat additions of 8% or less are recommended.



Feed Efficiency on the Farm

Keith E. Gilster
Extension Specialist
(Swine Nutrition)

Feed efficiency may be defined as the pounds of feed required to produce one pound of liveweight gain. To accurately measure feed efficiency, beginning and final weights for a group of pigs must be determined—as well as the amount of feed consumed between weights.

Pigs can be weighed easily in groups at the beginning and end of the test period. If feed efficiency is calculated from birth, the birth weight may be used as the beginning weight. If the producer doesn't want to weigh the pigs at birth, a representative birth weight may be used. However, if feed efficiency is calculated from a later weight such as 40 pounds, the beginning weight must be determined. The final weight can be taken immediately as pigs are removed from their pens or the weight at the market place can be used. Using the weight at the market place eliminates the final weighing of the pigs at home.

An accurate measurement of the feed consumed is important. If complete feed is purchased, the purchase weight can be used in calculating feed efficiency. If a grinder-mixer is used, the determined amount in the mixer can be used as the weight for calculation. If feed is dropped on the floor, the amount dropped can be used in calculation.

The amount of feed left in the feeders at the end of the test must be subtracted from the total amount put in the feeders. This means the amount of feed left in the feeders must be determined. This may be done by:

1. The feeders can be cleaned out and the feed weighed.

2. An empty weight of the feeders can be predetermined. Then the weight of the feeder containing the remaining feed is weighed. Subtraction of feeder weight determines the amount of feed remaining.

Why Measure?

Measurement of feed efficiency

(continued on next page)

Feed Efficiency . . .

(continued from page 17)

may help you find where feed wastage is occurring.

Feed efficiency does not have to be determined on all pigs raised during a given year. A sample of pigs may be used. The sample should represent the typical farm situation. The sample of pigs should contain the common genetic and health background found on the farm, should be fed the same diet that is used and should be raised under the housing and environmental conditions commonly experienced.

If pigs are outside, feed efficiency will be reduced in the winter as compared to the summer. You may wish to compare certain housing systems or diets. This means you must set up an on-the-farm test. Ask your county extension agent for help. An accurate test is necessary if a valid comparison is to be made.

For example, imagine two diets are to be compared. Each diet treatment should have the same number of barrows and the same number of gilts on test since barrows usually grow faster but generally have more backfat than gilts. All pigs should have a similar beginning and final weight. Housing systems should be alike and similar feeder and water space should be available. If pigs have access to outside conditions, then these conditions, such as weather, should be similar for all pigs on test. All pigs on test should have a similar genetic and health background. Everything should be as nearly alike as possible except the diets.

A similar program should be followed for comparison of housing systems. In this case, the only difference would be the type of housing being studied.

Feed efficiency can be determined from:

1. Birth to market weight.

2. A weight after birth (such as 40 pounds) to market weight.

3. Birth to market weight plus the amount of feed consumed by the breeding herd prorated over the number of pigs sold. A high conception rate and litter size would favor less feed to prorate to each pig and a subsequent higher feed efficiency for that pig. This means accounting for the feed consumed by the breeding herd which includes pre-gestation, gestation and lactation plus the boar.

Table 1. Example ot prorating the sow feed per pig.

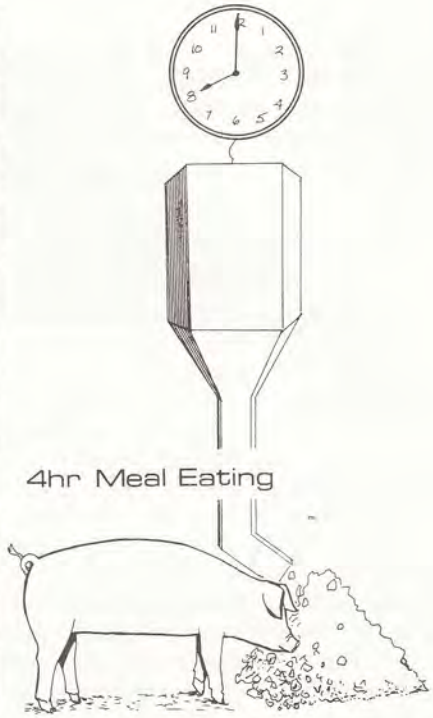
	Producer A	Producer B
Pigs per litter	7.06	9.0
Litters per sow per year	1.8	2.0
Pigs per sow per year	12.7	18.0
Pounds of feed per sow per year	2,250	2,250
Prorated lb of sow feed/pig	177	125

This means a savings of 52 lb of sow feed/pig by Producer B (Table 1). A sow nursing a larger litter may consume more feed during lactation. However, this difference is not large enough to merit consideration when discussin the situation of Producers A and B.

Reduce Feed Wastage

Pork producers should attempt to reduce feed wastage. However, optimum feed efficiency may not always mean optimum profit. For example, one type of housing system may allow for a superior feed efficiency, but this housing system may not be the method of choice because of economics and/or management and production programs. The reason might be the increased cost of the housing system. The same is true of diets.

Feed represents 60 to 75% of the total costs of pork production. The causes of feed wastage may be many such as poor health, inadequate nutrition, improper genetic background or poor facilities and equipment. However, pork producers must find these causes and strive to reduce the pounds of feed required to produce a pound of liveweight gain.



Nibbling Vs Meals

A. J. Lewis
Research Associate, Swine Nutrition

E. R. Peo, Jr.
Professor, Swine Nutrition

Experiments with laboratory animals (particularly rats) suggest that feed efficiency may be improved when animals consume their daily feed in "meals" rather than "nibble" all day. If this were true for growing pigs, there would be practical possibilities for improving feed efficiency by changing the feeding habits of pigs from "nibbling" to "meal eating."

An experiment was conducted to determine whether the feeding pattern of growing-finishing swine influences their efficiency of feed utilization.

Twenty-four crossbred barrows weighing about 84 pounds were allotted to two treatments:

1. 24 hrs/day—animals were allowed *ad libitum* access to self feeders.

2. 4 hrs/day—animals were al-

lowed access to self feeders for only 4 hrs/day (8:00 am to 12:00).

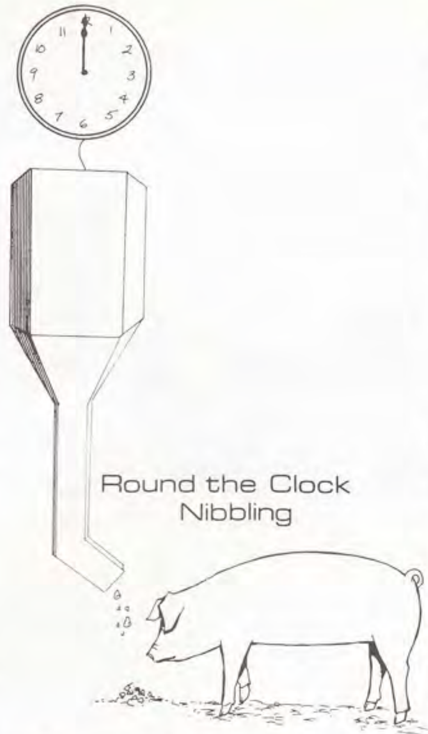
All animals were penned individually with *ad libitum* access to water. Both treatments received a high-lysine corn/SBM diet, containing 14% crude protein. The experiment was continued until animals reached 190-200 pounds.

A feeding period of four hours was chosen for treatment two because a preliminary experiment indicated that pigs were able to consume a days feed in this time. The object of the experiment was not to restrict the *intake of feed* of the pigs in treatment two, but only to restrict their *time of access to feed,* and thus force them to eat in "meals" rather than "nibble".

Results of the experiment are presented in Table 1. During the first three weeks of the experiment the pigs fed for 4 hrs/day did not consume as much feed as those fed for 24 hrs/day. As would be expected, they gained at a slower rate, but were about 7% more efficient (F/G ratios 2.61 vs 2.81). During the next five weeks, the feed intake of the two groups was essentially the same, gains were identical and there was no difference in feed conversion. Thus during the period when intake was about the same and only the feeding pattern was different, performance of the two groups was essentially the same.

All animals were penned individually. There was no competition for feeder space in either treatment. Different results might have been obtained if animals had been penned in groups.

At slaughter the intestines of all pigs were removed and examined. In laboratory animals some of the improvement in feed efficiency from "meal feeding" appears to be related to anatomical changes in the intestine. In this experiment, however, there were no significant differences in whole gut weight, stomach weight, or small intestine length between the two groups. There were minor differences in the carcass composition of the two groups with those fed 4 hrs/day having a significantly lower dressing percentage and a small (nonsignificant) reduction in backfat thickness. These differences were



probably related more to the lower feed intake during the first three weeks than to the different feeding patterns.

This experiment indicates that there is little or nothing to be gained by trying to change the growing-finishing pig from a "nibbler" to a "meal eater."

Table 1. Effect of different feeding patterns on performance and composition of growing-finishing swine.

		Feeding pattern	
Item	Unit	24 hr/day	4 hr/day
Initial wt.	lb	84.2	83.4
Final wt.	lb	197.9	191.6
Feed intake			
(days 1-21)	lb/day	5.91	4.78
(days (22-54)	lb/day	7.21	6.94
(days 1-54)	lb/day	6.70	6.00
Weight gain			
(days 1-21)	lb/day	2.09	1.84
(days 22-54)	lb/day	2.12	2.12
(days 1-54)	lb/day	2.12	2.01
Feed/gain			
(days 1-21)		2.81	2.61
(days 22-54)		3.42	3.22
(days 1-54)		3.18	3.00
Whole gut weight	lb	13.27	14.44
Stomach weight	lb	1.46	1.52
Small intestine length	ft	55.90	55.90
Dressing	%	76.39	73.87
Backfat thickness	in.	1.45	1.37
Ham and loin	%	37.67	39.44

Past—Present—Future

Disease Diagnosis

Oliver D. Grace
Professor, Diagnostic Laboratory

Disease outbreaks can be costly to the livestock producer. A program of disease prevention will, in the long term, keep the loss at a minimum. When disease does occur, a quick identification (diagnosis) of the disease and its cause are a must. Treatment without knowledge of the specific disease condition present may be wasteful and ineffective.

Swine producers and other stockmen turn to their veterinarian for help in diagnosing disease problems. On occasion the veterinarian may require the help of laboratory procedures to make a definite diagnosis. Such help is provided by the diagnostic laboratories of the University of Nebraska located in Lincoln and North Platte. In the future, a laboratory will be available at Scottsbluff.

The Department of Veterinary Science has long given assistance to the livestock industry. At one time all staff members were involved in diagnosing disease problems. This took the time of people concerned primarily with teaching and research and interfered with preassigned responsibilities.

Research Stimulated

Many of the disease problems found in these examinations have developed into important research projects. The resulting information has helped stockmen in disease control and prevention. Some of the more common swine diseases that have stimulated research are:

(continued on next page)

New diagnostic laboratory will open soon.

1. Erysipelas — The first effective vaccine was developed here at Nebraska.

2. Hog Cholera — Vaccine was produced at the University for distribution in the state. Later studies led to the development of a diagnostic technique which contributed to the eradication of hog cholera in Nebraska.

3. Tuberculosis — Recognition of the disease and its transmission from poultry to swine.

4. Transmissable-gastro enteritis (TGE)—This isn't whipped yet, but much more knowledge is available about it and eventually will lead to a solution.

5. Greasy Pig — Exudative epidermitis — Identification of its cause was first made at Nebraska.

6. The SPF Program was developed at Nebraska to break the disease cycle and prevent diseases that were observed at the Diagnostic Laboratory.

(These are just examples and many more can be found in the swine area as well as in other animal species.)

After World War II Dr. F. Rex Woodring joined the department to provide a diagnostic service for those requesting it. No technical assistance was provided and he accomplished his assignment by hard work and diagnostic skill. A section of the old veterinary clinic building was remodeled and used as the diagnostic area. Further remodeling occurred about 1960, but essentially the same area has been used for nearly 30 years. Volume of work and the development of new laboratory techniques have grown greatly during this period of time.

New Facility

The recognition of the need for facilities, which permit a more thorough examination of specimens has led to the construction of a new Veterinary Diagnostic Center on the Lincoln campus. This facility, when fully equipped and staffed, will provide a diagnostic service which affords a more accurate and rapid determination of the disease problem present. It also will serve as a reference laboratory for the North Platte and Scottsbluff laboratories and provide services not available there.

Areas which will be added in the new center include: virology, mycology, and toxicology. There will be improved services in gross pathology, microscopic pathology, bacteriology, serology and parasitology, which are the areas now offered.

The exact date of the transfer to the new building at the N.E. corner of the intersection of Fair St. and the East Campus Loop isn't certain. However, it probably will be early in 1976.

Construction of the Veterinary Diagnostic Center was made possible by joint efforts of pork producers and other livestock and poultry groups. All involved or interested people can be proud of the results of their efforts and are invited to visit the Center when in Lincoln.