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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

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Pigs and Protein Sources

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The current hog-corn ratio (number of bushels of corn that can be bought for the price of 100 pounds of pork) is about 22. A hog-corn ratio of 22 (break-even ratio is 14-15) indicates that we should be expanding swine production in Nebraska, yet we are producing fewer swine and our abundant supply of grain is being diverted for other uses or to produce swine in other parts of the country.

While we have feed and technical ability for Nebraska to move up to No. 2 or 3 in swine nationally, talk of expansion always brings criticism that we will flood the market with pigs and depress prices.

Obviously, if we are to expand swine production in Nebraska and still maintain a strong market, it must be done at the expense of other areas of the country now using "our" feed grains to produce swine.

It has been estimated, very conservatively, that Nebraska must expand its swine industry at least 40% by 1980 just to maintain its current position (6th) in swine production based solely on population growth with little or no increase in per capita consumption of pork.

Misleading Ratio?

Why hasn't swine production increased markedly in Nebraska? There are many factors involved. However, a major point might be that the hog-corn ratio can be misleading—that is, it takes more than corn (grain) to produce pigs. Feed represents 65-75% of the cost of producing swine and 25-35% of the total feed bill is for supplemental protein.

Whether manufactured or home-mixed, soybean meal has been a superb base source of supplemental protein for swine. However, because soybean meal is an excellent protein for man as well as animals, demand has caused the price of soybean meal to skyrocket. Bad weather in the fall of 1972, affecting the harvest of soybeans, will play a role in bringing about higher prices for soybean meal in 1973.

In fact, nothing in the future—even a large expansion of soybean production—suggests that soybean meal will again enjoy the favorable role it once played in swine production. If this becomes true, the swine producer is faced with renewing his interest in former sources or looking for new sources of supplemental protein for swine.

Computer Will Tell

The feed manufacturer, with his ready access to the computer, has never been in a more favorable position to serve the swine industry than he is today.

How? The feed manufacturer, with his broad base and volume buying, can ask the computer to bring together those protein sources and amino acids which will provide the lowest cost protein supplement and still assure optimum performance in swine.

Large swine producers, too, may be in a competitive position to seek computer aid (available privately) to determine "Least cost" formulation of rations from feed-

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Pigs and Protein

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stuffs available locally. Regardless, it appears that the computer will tell the swine producer which supplemental proteins he will be using.

The computer, whether it is used by the feed manufacturer or the swine producer, will only do what it is told. That is, what protein sources are available, what restrictions should be placed on their use and what performance standards must be maintained.

Table 2. Effect of level of meat and bone meal on gains and feed conversion of G-F swine (Nebraska Station).

	Corn-soy basal[a]	2.5% MBM[b]	5.0% MBM[b]	7.5% MBM[b]	10% MBM[b]
Av daily gain, lb[c]	1.63	1.61	1.44	1.44	1.26
Feed/lb gain, lb[c]	3.28	3.37	3.36	3.36	3.40

[a] 14% protein diet, calcium-phosphorus levels adjusted to levels in the 10% MBM diet for all treatments.
[b] MBM = Meat and bone meal, blend of four sources.
[c] 98 day test, int wt 43 lb, 2 pens, 7 pigs/pen.

The information provided to the computer must be accurate and must be based on research to support the information fed into the computer. Thus, the Nebraska Experiment Station plays—and will continue to play—an extremely critical role in evaluating old and discovering new sources of protein that will serve the needs of the swine industry to lower production costs. Lowered production costs will allow the Nebraska swine industry to continue to provide a highly nutritious, healthful, delectable product of reasonable cost to the consumer.

Some but not all of the sources of supplemental protein which can be used for swine in Nebraska are shown in Table 1.

As indicated earlier, the purpose of the swine research program at the Nebraska Experiment Station is to determine how to more efficiently use "old" sources and identify new sources of supplemental protein for swine. Examples of research from the Nebraska Experiment Station which will help make judgments about how to effectively use protein sources available in the Midwest are shown in Tables 2, 3, 4, 5 and 6.

Table 1. Sources of supplemental protein for swine, their characteristics and recommended rate of use.

		For Nebraska		
Protein source	Characteristics	Current price/unit of protein compared to soybean meal	Availability	Normal limitation in ration
Plant Proteins				
Soybean meal	Excellent quality Uniform, palatable	....	Excellent	None
Safflower meal	Quality good, low in lysine	Higher	Poor	None
Cottonseed meal	Quality good but low in lysine; gossypol toxicity poses problem	Higher	Good	10%
Linseed meal	Quality good but low in lysine	Higher	Fair	None
Peanut meal	Quality fair but low in lysine	Higher	Poor	None
Sunflower seed meal	Quality fair but low in lysine	?	Poor but may get better	None
Corngluten meal	Quality poor, low in lysine, tryptophan	Lower	Good	10%
Animal Proteins				
Fish meal	Quality excellent	Higher	Poor	None
Meat and Bone meal	Quality variable, low in tryptophan; Greater potential for rancidity and salmonella contamination than plant proteins	Generally higher but can be lower, locally	Good	5.0%
Dried skim milk	Excellent quality	Much higher	Good	None
Dried buttermilk	Excellent quality	Much higher	Good	None
Tankage	Quality variable, greater potential for rancidity and salmonella contamination than plant proteins	Lower	Good	None
Blood meal	Quality fair, palatability poor	Lower	Good	2%
Hydrolyzed feather meal	Quality fair	Lower	Poor but may get better	5%
Hydrolyzed leather meal	Quality variable	Lower	Poor	1%

Available in Nebraska

Generally, animal proteins such as tankage, meat and bone meal and blood meal are readily available in Nebraska and often can be purchased locally at less cost per unit of protein than soybean meal or other plant proteins.

There are two or three major problems associated with packing house by-products. Because of their relative high fat content, tankage and meat and bone meal are more susceptible to rancidity. Thus, storage for volume buying at the most economical time becomes a major problem for the swine producer or feed manufacturer.

Recent surveys indicate that animal by-product proteins have a

Table 3. Effect of amino acid supplementation and level of protein on the value of meat and bone meal for G-F swine (Nebraska Station).

	Corn-soy Basal[a]	10% MBM[a]	10% MBM + TRY[a b c]	10% MBM[a]
Level of protein, %	*14*	*14*	*14*	*16*
Av daily gain, lb[d]	1.68	1.56	1.74	1.77
Feed/lb gain, lb[d]	3.28	3.23	3.33	3.24

[a] All diets balanced to same level of calcium and phosphorus.
[b] Meat and bone meal, blend of four sources.
[c] TRY = Tryptophan added to equal level in corn-soy basal.
[d] 77-day test. Int wt 56 lb, 2 pens, 8 pigs/pen.

Table 4. Value of high protein alfalfa meal for G-F swine (Nebraska Station).

	Corn-soy Basal[a]	½ of supplemental protein from alfalfa meal[a b]	All of supplemental protein from alfalfa meal[a b]
Av daily gain, lb[c]	1.92	1.72	1.39
Feed/lb gain, lb[c]	3.14	3.11	3.75

[a] 14% protein diets.
[b] Alfalfa meal analyzed 31.9% protein. Diets not adjusted for differences in fiber content.
[c] 42-day test. Int wt 80 lb; 2 pens, 6 pigs/pen.

higher level of salmonella contamination (an organism which can cause dysentery in swine) than plant proteins. Therefore, it is extremely important to purchase high quality meat and bone meal or tankage products.

Quality of tankage and meat and bone meal tends to be more variable than soybean meal since the products are made from trimmings from the packing house kill floor, inedible parts and organs and condemned carcasses.

Data in Table 2 show that gains and feed conversion decrease markedly when a ration contains more than 2.5% meat and bone meal but that 10% can be used effectively as a source of supplemental protein when tryptophan (a deficient amino acid in a corn-meat and bone meal diet) is added to the diet or by simply feeding 2% more protein, 16 vs 14%, Table 3, Obviously, adding tryptophan or raising the level of protein 2% will increase the cost of the ration. Thus, on this basis soybean meal might be a better "buy."

Alfalfa a Substitute?

It has been estimated that alfalfa will produce 2-2½ times more protein per acre than soybeans and doesn't have to be planted and cultivated yearly. We have not even scratched the surface on the potenial of alfalfa as a source of protein for swine.

Yet, if one looks at the data in Table 4, gains and feed conversion on a high protein alfalfa meal (31.9%) decreased as level of alfalfa increased in the diet. However, recent research at the Nebraska Station indicates that method of processing alfalfa meal is a major factor limiting gains and feed conversion of swine.

Freeze-dried alfalfa meal (prepared for us by Dr. George Kohler and A. Livingston, USDA, ARS, WRRL, Berkeley, California) improved feed conversion of baby pigs 15% when compared to conventional heat-dried alfalfa meal. While freeze-drying is not feasible on a practical basis at the moment, research with freeze-dried alfalfa meal shows that the value of alfalfa protein for swine can be markedly improved by altering processing method.

The results of research conducted on leather meal and mustard seed meal at the Nebraska Station are shown in Tables 5 and 6. Hydrolyzed leather meal, by law, can only be used at 1% of the diet.

Table 5 shows gains and feed conversion decrease slightly when 1% leather meal is added to the diet and decrease markedly when 2.5% leather meal was fed with or without amino acid supplementation. Since leather meal is a relatively inexpensive source of protein, the computer might select it at the 1% level. Don't be concerned. The pig can make some use of leather meal protein.

(continued on next page)

Table 5. Hydrolyzed leather meal for G-F swine[a] (Nebraska Station).

	Treatments				
	1 Corn-soy basal	2[b] Corn-soy +1%LM[d e]	3[b] Corn-soy +2.5%LM	4[b c] Corn-soy +1%LM+AA	5[b c] Corn-soy +2.5%LM+AA
Av daily gain, lb	1.72	1.65	1.56	1.63	1.57
Feed/lb gain, lb	3.29	3.40	3.50	3.36	3.43

[a] Leather meal and grant support for research from Hy-Nite Corporation, Oak Creek, Wisconsin.
[b] 84-day trial. Conducted in open-shed type confinement on concrete. Yorkshire x Hampshire crossbred pigs. Int wt 60 lb; 2 pens, 8 pigs/pen.
[c] Diets 2, 3, 4 and 5 isonitrogenous with Diet 1, a 14% crude protein diet fed throughout trial.
[d] Lysine, methionine and tryptophan added to equal the levels of these amino acids in Diet 1.
[e] LM = leather meal. 1% maximum by law.

Table 6. Value of mustard seed meal for G-F swine (Peterson and Danielson, Nebraska Station, North Platte).

	Level of mustard meal fed, %			
	Growing Stage[a]			
	0	*10*	*20*	*30*
Av daily gain, lb[b]	1.87	1.72	1.14	0.70
Feed/lb gain, lb[b]	3.30	3.44	4.14	5.56
	Finishing Stage[c]			
	0	*5*	*10*	*15*
Av daily gain, lb[b]	1.72	1.67	1.54	1.47
Feed/lb gain, lb[b]	4.20	4.28	4.42	4.56

[a] 16% protein diets fed for first 21 days; mustard seed meal approx 35% protein.
[b] Two pens, 8 pigs/pen.
[c] Protein level reduced to 14% and mustard meal reduced 50% in each diet. Diets fed to market weight.

Pigs and Protein

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Mustard seed meal contains a factor which tends to depress growth and is rather unpalatable, which may account for the reduced gains and feed conversion of pigs fed varying levels of mustard meal (Table 6).

If research finds a way to remove the anti-growth and palatability factors of mustard meal, this product could be a limited but useful source of protein for swine in certain areas of Nebraska

Our search for new protein sources or ways to improve the utilization of traditional ones by swine will continue to be an important part of our program. However, there are other critical areas of research on protein requirements of swine which can also have significant economic impact.

Things to Blame

One "man-made" problem related perhaps to protein requirements is the reduced performance of swine raised on slats in so-called "environmentally-controlled" housing.

Most swine producers with environmentally-controlled production units have experienced the problem and have blamed it on many things, including reduced feed intake.

It has been proposed that pigs raised in environmentally-controlled housing need less feed (energy) to maintain body temperature in the winter, or have less opportunity to get rid of excess body heat in the summer, thus eat less feed under both situations.

If this is true, then perhaps reduced performance is not so much one of a lack of energy feeds but may be due to a lack of sufficient protein, minerals or vitamins to meet daily body requirements.

To study the problem, we conducted an experiment to determine the effect of nutrient density (protein, minerals and vitamins) on gains and feed conversion of swine raised on 2/3 slats in an "environmentally-controlled" house.

Two levels of protein were fed—14 and 18%. A normal level of minerals and vitamins was fed with both levels of protein. Other treatments included a doubling of the vitamins added to the diets, a 50% increase in the minerals and combinations of both increased minerals and vitamins with 14 and 18% protein. Results are shown in Table 7.

Pigs fed 18% protein gained faster but slightly less efficiently than those fed 14%. However, even though the difference in average daily gain was 0.1 lb/day, it is doubtful that we can justify the 18% protein level with the current high cost of supplemental protein.

Doubling the vitamin level had little effect on gains but tended to depress feed conversion. Increasing the mineral levels by 50% caused a sharp drop in gains at 14% protein but not at 18%.

Overall, the best gains and feed conversion were obtained with normal levels of protein, minerals and vitamins, suggesting at least that lack of nutrient intake (other than energy) is not a prime factor in the reduced performance observed in pigs raised in "environmentally-controlled" housing.

Perhaps the most significant recent discovery which could have the greatest impact on the survival of the swine industry as a producer of red meat is *high lysine corn.* Good reports were given on high lysine corn by Moser and Bitney in the 1972 Nebraska Swine Report. Two more articles on high lysine corn and its impact on the swine industry are included in the 1973 report.

Table 7. Effect of nutrient density on G-F swine raised in confinement[a] (Nebraska Station).

	Protein Level, %		Av for Mins-Vits
	14	18	
	Av daily gain, lb[b]		
1 X Min – 1 X Vits (Normal additions of mineral and vitamins)	1.59	1.61	1.61
1 X Min – 2 X Vits[c]	1.54	1.65	1.61
1.5 X Min – 2 X Vits[c d]	1.50	1.61	1.57
Av for protein	1.54	1.63	
	Feed Required/lb Gain[b]		
1 X Min – 1 X Vits	3.52	3.51	3.52
1 X Min – 2 X Vits	3.70	3.69	3.70
1.5 X Min – 2 X Vits	3.62	3.78	3.70
Av for protein	3.61	3.66	

[a] Completely enclosed house; floors 2/3 slatted, 1/3 solid.

[b] Av 2 pens, 8 pigs/pen. Int wt 72 lb.

[c] Level of Vitamins A, D, Riboflavin, Niacin, Pantothenic Acid, Choline and Vitamin B_{12} were added at double the rate used at the 1 X level.

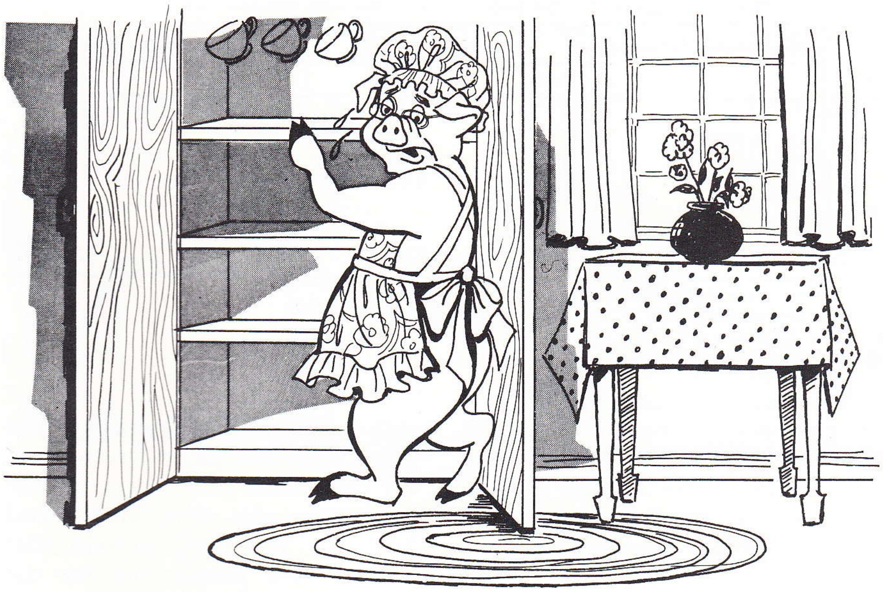
[d] Level of salt, calcium, phosphorus, manganese, iodine, copper, iron and zinc were increased 50% over the 1 X level.

Summary

As indicated in *Table 1,* soybean meal probably is still the best buy for a single source of supplemental protein. If tomorrow we suddenly started using only animal protein sources, existing and future supplies would be quickly exhausted and become price prohibitive for use in swine feeds. When the pig competes with man for protein, man will win out.

With high lysine corn, the pig can make it easily from 100 lb to market weight on high lysine corn, minerals and vitamins. With protein suplement, 2% less protein is needed at each stage of the life-cycle with high lysine corn for optimum gains and feed conversion than with normal corn.

Swine producers today should consider very seriously where and if high lysine corn fits into their production program. *We think it does.* Feed manufacturers, too, must be ready to provide the service to go with a high lysine corn feeding program. It, too, needs supplementation.



Pig Performance on Low Protein

P. J. Cunningham

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A new swine research project has recently been initiated. This project is designed to evaluate performance and investigate the potential for genetic improvement in pigs fed two different nutritional diets. The two diets studied are fed during the growing-finishing phase only.

One diet is a standard corn-soybean meal diet (14% protein). The other consists of high lysine corn, minerals and vitamins.

The high lysine corn diet was chosen because it represents a diet considered suboptimal by present standards for protein level. In addition, this diet contains no supplemental protein. If the human population continues to increase, the demand for plant protein for human consumption will undoubtedly increase. The time may come when plant protein will no longer be available for livestock. Pigs will have to perform on lower protein diets if the industry is to survive.

High lysine corn is being used instead of regular corn because high lysine corn has a higher protein content and a better balance of amino acids. This should prevent too drastic a reduction in dietary protein level initially. Data represent performance of the first group of pigs fed the two diets.

Performance of Gene Pool boars and gilts is shown in Table 1. Daily gain was calculated for the period from weaning to removal from test at approximately 175 lb.

Table 1. Performance of boars and gilts fed 14% and 10% protein diets.

Trait	Corn-soy (14%)[a] Boars	Corn-soy (14%)[a] Gilts	High lysine (10%)[a] Boars	High lysine (10%)[a] Gilts
Number[b]	132	138	54	67
Daily gain, lb/day				
Average[c d e]	1.43	1.38	1.03	1.18
Range	0.76-1.97	0.73-1.81	0.50-1.78	0.40-1.87
Probe, in				
Av[c d e]	1.24	1.39	1.52	1.58
Range	0.78-1.67	0.91-1.78	1.19-2.00	0.96-2.41

[a] Level of protein in total diet
[b] Number of pigs probed
[c] Diet differences ($P<.001$)
[d] Sex differences ($P<.025$)
[e] Diet x sex interaction ($P<.05$)

Backfat probes are adjusted to a 200-lb equivalent. Daily gains were calculated for all pigs but probes were taken only from pigs weighing at least 150 lb after 150 days on test. Five pigs on the 14% diet and 18 pigs on the 10% diet were not probed.

Pigs fed the 10% protein diet grew slower (0.25 lb/day) than pigs fed the 14% protein diet. The 10% protein diet, as expected, was a suboptimal diet for supporting maximum growth potential in these pigs. Boars were more severely affected than gilts, indicating that critically low levels of protein affect boars more readily than gilts.

Lean-Fat Ratio

Even though slower growing, pigs fed the 10% protein diet were fatter (0.23 in.). This indicates that pigs fed the low level of dietary protein produced a higher ratio of fat to lean than pigs fed the higher level of dietary protein. Dietary protein level does have an affect on the growth of different body tissues.

It is interesting to note by examining the ranges, that some pigs did perform at an acceptable level on the 10% protein diet. It may be possible through selection to obtain pigs which will perform on this diet.

To obtain information relative to carcass characteristics of pigs fed the two diets, 43 Gene Pool barrows and 48 gilts were randomly selected for carcass evaluation. These pigs were fed in a totally enclosed, partially slatted floor building.

Daily gain and probe data were collected similarly to the data for Gene Pool boars and gilts. Three pigs fed the 14% protein diet and nine pigs fed the 10% diet were not probed due to a failure to meet minimum weight requirements. Efficiency and intake figures are based on the first 91 days of the feeding period. Pigs were slaughtered at an average weight of 215 lb. Table 2 summarizes the performance and carcass characteristics of these barrows and gilts.

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Pig Performance

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Pigs fed the 14% protein diet grew at a faster rate (0.40) lb/day) and were leaner (0.21 in) than pigs fed the 10% protein diet. Barrows outperformed gilts for growth rate on both diets but the difference was greater for the 10% protein diet (0.19 vs 0.13 lb/day). These data coupled with the boar and gilt data demonstrate that boars require the highest level of dietary protein, followed by gilts, then barrows, for maximum growth performance.

The 10% protein diet greatly reduced the efficiency (3.87 vs 3.20) compared to feeding the 14% protein diet. Fat deposition requires more energy than lean deposition. Therefore, part of the explanation for the poorer efficiency of pigs fed the 10% diet may be the result of their depositing more fat in relation to lean. In addition, pigs fed the low protein diet consumed less feed per day (0.66 lb). They apparently did not consume enough feed above maintenance to allow for maximum efficiency. The exact cause of the lower daily consumption is not known at this time.

Faster Lean Growth

More desirable carcasses were obtained from pigs fed the 14% protein diet. Their carcasses had less backfat, a greater percent ham and loin and larger loin eye area. Rate of lean growth, measured as pounds of ham and loin per day of age, was also greater for pigs fed the 14% protein diet. These data indicate the importance of dietary protein level in determining carcass desirability and maximizing rate of growth of lean tissue.

Gene Pool pigs might not be classified as meat type pigs by present day standards. Thus, their performance on these diets might not be indicative of the response to be expected from meat type pigs. To evaluate this point, a group of pigs which more nearly fit the meat type ideal were fed the two diets. This evaluation involved 79 pigs fed the 14% protein diet and 47 pigs fed the 10% diet. Five pigs fed the 14% diet and 23 pigs on the 10% diet were not probed for failure to meet minimum weight requirements after 200 days on test. The performance of these pigs is shown in *Table 3*.

Diet differences obtained for meat type pigs on the two diets were in the same direction as those obtained for Gene Pool boars and gilts. However, the magnitudes of the differences were larger for the meat type pigs (0.41 lb/day and 0.41 in). The 10% protein diet was an even poorer diet for the meat type pigs than the Gene Pool pigs. Boars, again, were the most severely affected by the low protein diet.

The obvious difference between the two types of pigs is the average performance level. Meat type pigs gained slower on both diets. Protein requirements may be different for different types of pigs. The 14% protein diet may be a suboptimal diet for meat type pigs, particularly during the period immediately postweaning. Selection for performance on low protein diets may be more difficult with meat type pigs due to the fewer number of pigs which will perform on this type of diet.

Table 3. Performance of meat type pigs fed 14% and 10% protein diets.

Trait	Corn-soy (14%)[a]		High lysine (10%)[a]	
	Boars	Gilts	Boars	Gilts
Number[b]	32	41	8	16
Daily gain, lb/day				
Av[c d]	1.14	1.07	0.64	0.74
Range	0.52-1.45	0.59-1.28	0.27-1.04	0.35-1.08
Probe, in				
Av [c]	0.98	1.00	1.38	1.43
Range	0.76-1.36	0.79-1.25	1.17-1.54	1.22-1.66

[a] Level of protein in total diet
[b] Number of pigs probed
[c] Diet differences (P<.001)
[d] Sex x interaction (P<.05)

Table 2. Performance and carcass characteristics of barrows and gilts fed 14% and 10% protein diets.

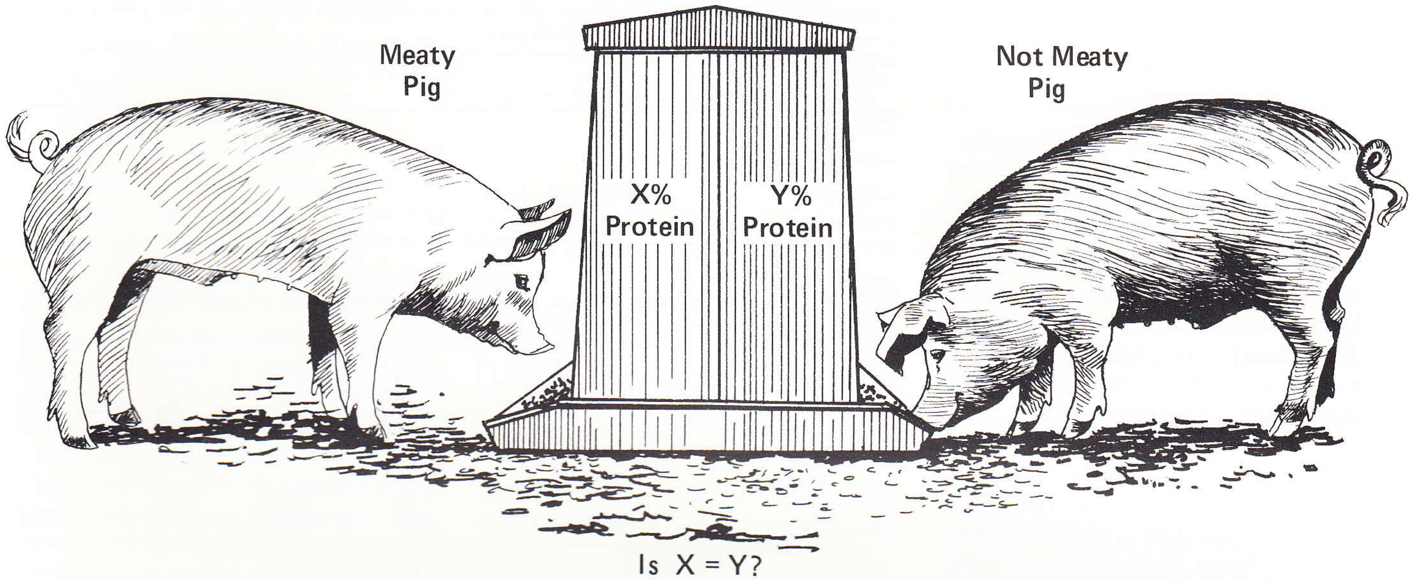
Trait	Corn-soy (14%)[a]		High lysine (10%)[a]	
	Barrows	Gilts	Barrows	Gilts
Number[b]	20	20	15	13
Performance				
Daily gain, lb/day[c d]	1.56	1.43	1.20	1.01
Probe, in[c]	1.37	1.36	1.58	1.56
Efficiency, feed/gain[c]	3.22	3.19	3.86	3.89
Intake, lb/day[c d]	5.03	4.55	4.36	3.90
Carcass[e]				
Length, in	30.1	30.5	30.0	30.2
Backfat, in[c]	1.53	1.53	1.74	1.66
% ham and loin[c]	41.2	42.5	40.1	40.1
Loin eye area, sq in[c d]	4.08	4.52	3.39	3.63
lb ham and loin/day of age[c]	0.34	0.35	0.31	0.31

[a] Level of protein in total diet
[b] Number of pigs slaughtered
[c] Diet difference (P<.005)
[d] Sex difference (P<.025)
[e] All carcass traits adjusted for differences in carcass weight

Summary

Data from the base population of an experiment involving two nutritional regimes indicate:

1. A 10% level of dietary protein decreases daily gain and increases backfat compared to a 14% protein diet.
2. Boars require the highest level of dietary protein followed by gilts and then barrows.
3. Feeding a 10% protein diet decreases carcass desirability.
4. The detrimental effects of the 10% level of dietary protein were greater for the meatier pigs.
5. The question of whether pigs can be selected to perform on low protein diets remains to be determined.



Protein Levels for Meaty, Non-Meaty Pigs

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There has been a major effort in the pork industry to select pigs with a greater lean to fat ratio. This selection pressure has resulted in a very significant increase in the average percent lean cuts in the hogs marketed during the past few years.

One of the major factors that influence the composition of the carcass is heredity. Heritability estimates are 50% or higher for most carcass traits, indicating that selection of parents with a high lean to fat ratio will increase carcass leanness of the offspring.

Another factor related to carcass leanness in swine is the nutritional program. It is apparent that a hog cannot produce to the maximum of its genetic potential unless it is provided optimal environmental conditions. Therefore, we would not expect an animal to express its maximum genetic ability under poor environmental conditions whether it be nutrition, housing or management.

An important question has been, "Are the protein requirements the same for the lean pig as they are for the pig that has not been selected for increased leanness?" If the answer to this question is no, there might be value in selecting the protein level for finishing swine based upon the animals' genetic ability to gain efficiently and produce a lean carcass.

Several research workers have attempted to identify the optimum dietary protein level for different types of swine. The results available are not conclusive.

Research Procedure

A University of Nebraska study involving two experiments was conducted using two different genetic lines. Each genetic line was fed both a 12% and 16% corn-soybean meal diet during the finishing period (130 to 225 lb).

The genetic lines used in this study differed in their genetic base. One line was the Gene Pool which had no selection pressure applied to performance or carcass traits. The Gene Pool is of mixed genetic background having 14 different breeds introduced into the herd. It is a closed, random mating herd. The other genetic line used in this study was a purebred Hampshire line that was developed to be representative of the meaty hogs being produced today. Selection was applied in this line for a meaty type and low backfat.

The study was designed to evaluate the response in rate and efficiency of gain and carcass characteristics of the two genetic lines to the different dietary protein levels.

Lincoln and Mead

In the first experiment 72 barrows were finished under drylot conditions at the Adams St. Swine Center near Lincoln. In the second experiment 120 barrows were finished in an environmentally regulated confinement facility with concrete floors (75% slotted) at the Mead Field Laboratory Swine Research Unit.

All pigs were fed a 16% protein diet from an average initial weight of approximately 65 lb to an average weight of 130 lb. Pigs were fed either a 12 or 16% percent level from 130 lb to slaughter.

(continued on next page)

Protein Levels

(continued from page 9)

Genetic Differences

There was a significant difference in daily gain between the Gene Pool and Hampshire barrows finished in drylot. However, there was essentially no difference in average daily gain between the two lines in the confinement facility. The Hampshire pigs did not gain as rapidly as the Gene Pool pigs in the drylots. The difference in rate of gain between the two lines may be due to hybrid vigor. In a trait that is moderately heritable like rate of gain, a highly crossbred line like the Gene Pool might exhibit hybrid vigor.

The Hampshires were more efficient converters of feed to gain under both finishing facilities. Based upon rate and efficiency of gain these data indicate that the Gene Pool pigs have the genetic capability for more rapid growth but the Hampshires have the genetic potential for more efficient conversion of feed into pork. The rate and efficiency of gain results of the two experiments are shown in Tables 1 and 3.

Color, Marbling Scored

There was a significant difference between the lines in all of the quantitative carcass traits except carcass length in both experiments. The Hampshire barrows which had been selected for increased leanness were leaner than the Gene Pool barrows. The Hampshire barrows produced carcasses with significantly less carcass backfat and larger loin eye areas, percent ham and loin and percent lean cuts. Carcass results are in Tables 2 and 4.

In the second experiment data were obtained on carcass quality by subjectively scoring color and marbling of the loin eye. Gene Pool loins tended to be slightly darker in color and had slightly more marbling than Hampshire line barrows (about 1/2 unit closer to optimum).

Carcass results definitely indicate that Hampshires produced leaner

Table 1. Effect of dietary protein on rate and efficiency of gain of two genetic lines of swine under drylot conditions.

Genetic line	Protein level, %	No. of pigs	Gain, lb/day	Feed/Gain
Gene Pool	12	17	1.86	2.89
Gene Pool	16	18	1.75	3.18
Hampshire	12	18	1.63	2.99
Hampshire	16	17	1.61	3.04

Table 2. Effect of dietary protein on carcass characteristics of two genetic lines of swine under drylot conditions.

Genetic line	Protein level, %	Carcass backfat, in.	Loin eye area sq. in.	Percent ham and loin	Percent lean cuts	Carcass length, in.
Gene Pool	12	1.60	4.82	38.6	56.5	31.0
Gene Pool	16	1.54	4.76	39.2	57.1	31.3
Hampshire	12	1.39	6.32	42.2	61.0	30.6
Hampshire	16	1.35	6.25	42.0	61.1	30.5

Table 3. Effect of dietary protein on rate and efficiency of gain of two genetic lines of swine in confinement.

Genetic line	Protein level, %	No. of pigs	Gain, lb/day	Feed/Gain
Gene Pool	12	32	1.67	4.13
Gene Pool	16	32	1.62	4.02
Hampshire	12	28	1.60	4.05
Hampshire	16	28	1.68	3.84

Table 4. Effect of dietary protein on carcass characteristics of two genetic lines of swine in confinement.

Genetic line	Protein level, %	Carcass backfat, in.	Loin eye area, sq. in.	Percent ham and loin	Percent lean cuts	Carcass length, in.	Color score[a]	Marbling score[a]
Gene Pool	12	1.69	4.24	38.4	54.6	30.5	2.7	3.0
Gene Pool	16	1.63	4.47	39.2	55.2	30.5	2.8	2.7
Hampshire	12	1.36	6.09	43.2	60.7	30.6	2.3	2.5
Hampshire	16	1.32	6.13	43.7	61.0	30.7	1.9	1.9

[a] Subjective score: 1 (poorest) to 5, with 3 most acceptable.

carcasses than those in the unselected Gene Pool.

Protein Levels

Protein level in the ration did not significantly affect rate or efficiency of gain or any carcass characteristic in either experiment. However, there were some differences that should be recognized.

In dry lot both lines gained slightly faster on the 12% protein level than on the 16% protein level. When finished in confinement, Gene Pool barrows gained slightly faster on 12% protein but Hampshire barrows gained slightly faster on 16% protein.

Barrows of both lines were more efficient feed converters when fed 12% protein in drylot and when fed 16% protein in confinement. These results correspond with the gain results. This is expected, partly due to the relatively high genetic association that exists between rate and efficiency of gain.

Results of both experiments indicate that the Gene Pool pigs, which had not been selected for carcass leanness, gain as fast and as efficiently when finished on a 12% protein diet as on a 16% protein diet. The Hampshire pigs' rate and efficiency of gain were essentially the same on both the 12% and 16% protein levels under dry-

lot conditions. In confinement the Hampshire barrows did gain slightly faster and more efficiently on a 16% protein diet.

Carcass Leanness

Carcass traits were affected more by genetic line differences than by the protein level differences.

Carcass backfat was somewhat reduced in both lines when fed 16% protein in both experiments. In barrows finished in drylot, loin eye area was slightly larger for both lines when fed 12% protein. However, barrows of both lines fed the 16% protein diet in confinement produced carcasses with larger loin eye areas. The increase in loin eye area in the group of barrows fed 16% protein was more pronounced in the Gene Pool line (.23 sq. in. larger) than in the Hampshire line (.04 sq. in. larger).

Percent ham and loin and percent lean cuts were slightly greater from carcasses of Gene Pool barrows fed 16% protein compared to those fed 12% protein. This was true in both experiments. The Hampshire line barrows produced essentially the same percent ham and loin and percent lean cuts from both protein levels in both experiments.

Color and marbling scores obtained in the second experiment also showed very little response to the protein levels in the ration. The subjective color score was not affected. Marbling score was slightly more acceptable in the loins from barrows fed 12% protein. The effect of protein level was larger in the Hampshires. The 16% protein diet produced loins from the Hampshires which were slightly less desirable for both color and marbling.

Conclusions

Higher protein levels in the finishing ration may or may not increase rate and efficiency of gain and carcass leanness. In this study, high protein levels did not increase rate or efficiency of gain or carcass leanness. Even though the pigs in this study represented extremes in meatiness, no solid evidence was found to suggest that the meatier pigs had higher protein requirements.

Although differences were small, there were indications that:

In pigs that have been selected for increased carcass leanness, a 16% protein level may improve feed efficiency more than it improves rate of gain and carcass leanness.

A higher level of protein in the finishing ration may produce a greater benefit in the carcass of pigs of average leanness (less than 40% ham and loin and over 1.5 inches backfat) than in leaner swine. However, a 12% protein level during the finishing period is adequate to support good gains in swine of average meatiness.

The genetic ability of the line is the greatest determinant of growth rate and efficiency and carcass leanness. Selection of protein levels to use in the finishing ration of swine differing in leanness should be based upon optimum and efficient performance for the least cost.

Feed Less Protein With High-Lysine Corn

Bobby D. Moser
Assistant Professor, Animal Science

Last year we discussed the nutritive value of high lysine corn as a feed grain for swine. In that report it was concluded that high lysine corn was a superior feed grain for all phases of a swine feeding program. Although the comparison had not been made directly, it appeared that when high lysine corn is used as the major feed grain, the protein level in the diet could be lowered by 2% without any depression in performance.

Therefore, an experiment was designed to determine the effect of high lysine corn on gain and feed conversion when balanced with soybean meal to a protein level 2% lower than that of a normal corn-soybean meal diet and fed either as a meal or as a pellet.

Sixty-four crossbred barrows and gilts were randomly allotted to two types of corn (normal or high lysine) and to two methods of processing (meal or pelleted). The experimental design was two replications of a 2 x 2 factorial arrangement of treatments with eight pigs per treatment per replication.

Diets Compared

The experimental diets are shown in Table 1. The normal corn diets containing 16% protein were fed during the growing phase (54-130 lb) and the 14% protein, normal corn diets were fed during the finishing phase (130-190 lb). These were compared to diets containing high-lysine corn with protein levels of 2% less (14 and 12%), respectively, during the growing and finishing phases. The protein level was lowered when the pens averaged about 130 lb.

The protein content of the normal and high lysine corn grains was 10.5% and 10.1% respectively, and the lysine content for the two corns was 0.32% and 0.43% respectively. Due to the increased amino acid content of the grain, the high lysine corn diets contained an amino acid pattern similar to that of normal corn diets which were 2% higher in protein (16 or 14%).

Performance

Average daily gains were found to be similar for pigs fed either normal or high lysine corn diets, Table 2. During the growing phase, pigs fed the normal corn diets gained slightly faster than those fed the high lysine corn diets (normal, 1.58 lb vs 1.50 lb for high lysine), while the reverse was true during the finishing phase (normal, 1.74 lb vs 1.80 lb for high lysine). Therefore, when both the growing and finishing phases were considered, average daily gains were very similar. The normal corn diets pro-

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Table 1. Composition and cost of experimental diets.

Price/lb	Ingredients	Normal corn meal or pelleted 16%	Cost	14%	Cost	High lysine corn meal or pelleted 14%	Cost	12%	Cost
2¢	Normal corn (10.5%)[a]	1616	$32.32	1718	$34.36	....	$	....	$ ....
2¢	High lysine corn (10.1%)[b]	....	....	....	....	1701	34.02	1802	36.04
6¢	Soybean meal (49%)	307	18.42	203	12.18	221	13.26	118	7.08
5¢	Dicalcium phosphate	37	1.85	40	2.00	40	2.00	43	2.15
1¢	Ground limestone	9	0.09	7	0.07	7	0.07	6	0.06
1¢	Salt	10	0.10	10	0.10	10	0.10	10	0.10
10¢	Trace mineral[c]	1	0.10	1	0.10	1	0.10	1	0.10
25¢	Vit-AB-premix[d]	20	5.00	20	5.00	20	5.00	20	5.00
	Ingredient cost		57.88		53.81		54.55		50.53
	Mixing ($2.00/ton)[e]		59.88		55.81		56.55		52.53
	Pelleting ($3.00/ton)[e]		62.88		58.81		59.55		55.53

[a] Lysine content of normal corn 0.32%.
[b] Lysine content of high lysine corn 0.43%.
[c] Calcium Carbonate Company, Swine 10% Zn.
[d] Contributed the following amounts per lb of complete diet: Vit A 3,000 IU; Vit D 4 IU; riboflavin 1.6 mg; pantothenic acid 6.0 mg; niacin 16 mg; choline chloride 100 mg; Vit B_{12} 20 mcg; menadion sodium bisulfate 1.26 mg and aureomycin 20 mg.
[e] Ingredient and processing cost only; cost of transportation, etc., not included.

Feed Less Protein

(continued from page 11)

duced an average daily gain of 1.64 lb compared to 1.62 lb for the high lysine corn diets.

Improved feed conversion for pigs fed high lysine corn diets was very apparent during the growing and/or finishing phases. When both phases were considered high lysine corn improved feed conversion by 3.2% fed as a meal and 5.2% when fed in the form of a pellet.

This improvement in feed conversion would suggest that the high lysine corn diets were more efficiently utilized than were the normal corn diets.

Improved feed conversion for high lysine corn has also been reported by other experiment stations. Therefore, the results from this trial would indicate that when high lysine corn is used as the feed grain, the protein level in the diet can be lowered by 2% during the growing and finishing phases without any detriment to performance and with a possible improvement in feed conversion.

Economics

The economics of feeding high lysine corn is also an important consideration. Last year Dr. Bitney (Dept. of Ag Economics, University of Nebraska) stated that the value of high lysine corn, relative to normal corn, depends upon how it is used in a swine feeding program. Depending upon which approach (conservative or optimistic) was taken the worth of high lysine corn was estimated to be from $1.20 to $1.36 per bushel when normal corn was priced at $1.10 per bushel.

The estimated cost of the diets used in this study are presented in Table 1. Costs shown were calculated using the same price per pound ($2.00/cwt) for both normal and high lysine corn, while soybean meal was considered to be $120/ton or 6¢lb. Also a $2.00/ton mixing charge was included for all diets plus $3.00/ton for those that were to be pelleted. These costs do not include transportation charges.

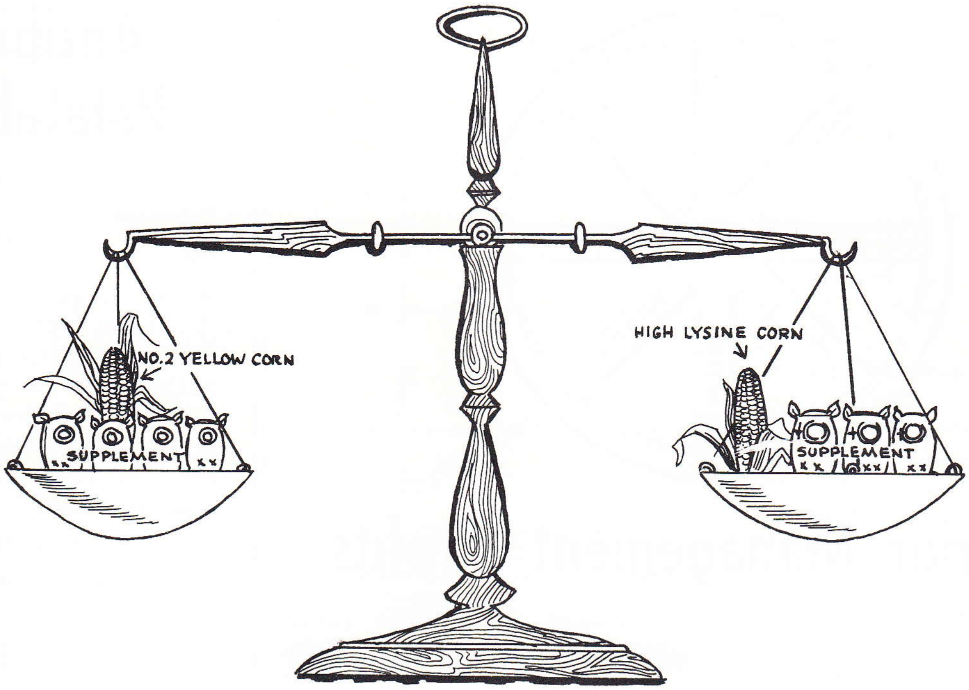
Meal and Pellets

When both normal and high lysine corn were considered to be the same price ($2.00/cwt) the economic advantage in feed cost was in favor of the high lysine corn diets (Table 2), as indicated by the lower cost per 100 lb of gain.

Table 2. Effect of high lysine corn on gain and feed conversion of G-F swine when fed as a meal or pellet and at a reduced protein level.

	Normal corn Meal 16-14	Pelleted 16-14	High lysine corn Meal 14-12	Pelleted 14-12
No of Pigs	15[a]	16	16	15[a]
Initial wt, lb	54.5	54.9	55.3	54.2
51-day wt, lb	132.8	136.7	131.2	130.9
Final wt, lb	187.9	193.1	185.9	191.2
Av daily gain, lb				
54-130 lb	1.54	1.61	1.49	1.50
130-190 lb	1.72	1.76	1.71	1.88
54-190 lb	1.61	1.67	1.58	1.65
Av daily feed, lb				
54-130 lb	4.97	4.52	4.52	4.07
130-190 lb	6.30	6.05	6.27	6.00
54-190 lb	5.48	5.12	5.20	4.81
Feed per lb gain				
54-130 lb	3.24	2.82	3.03	2.71
130-190 lb	3.66	3.45	3.68	3.19
54-190 lb	3.41	3.08	3.30	2.92
Feed cost/100 lb of gain with following corn price/cwt				
Normal corn, $2.00	$9.90	$9.36	$	$ ......
High lysine corn, $2.00	......	......	9.04	8.42
High lysine corn, $2.28	......	......	9.90[b]	......
High lysine corn, $2.36				9.33[b]

[a] One pig from these treatments died from unknown cause.
[b] Cost includes an advantage given to normal corn for slight increase in gain and added feed necessary to increase equal weights of pigs consuming both corns.



High lysine corn, fed as a meal, produced an 86¢/100 lb of gain advantage over normal corn, fed as a meal, while a 94¢/100 lb of gain advantage was observed when both corns were pelleted. This is due primarily to the lesser amount of soybean meal in the 2% lower protein diet of high lysine corn plus the improved feed conversion.

These data suggest that it is more economical to feed high lysine corn, if it can be bought or grown for the same price as normal corn. However, in the past, yields have not been quite as high as that of normal corn which tends to increase the cost of the high lysine corn.

As indicated previously, when both corns were considered to be the same price, there was a definite economic advantage in favor of high lysine corn, suggesting that the value of high lysine corn would be higher than normal corn.

As presented in Table 2, the same cost per 100 lb of gain ($9.90) would be obtained if the price of high lysine corn was considered to be $2.28/cwt compared to $2.00/cwt for normal corn, when both types of corn diets were fed as a meal.

When the diets were pelleted the price of high lysine corn could be increased to about $2.36/cwt before the cost of gain was increased to that of the normal corn pelleted diets, which suggests the value of high lysine corn to be 28¢ to 36¢/cwt above normal corn when the price of normal corn is considered to be $2.00/cwt and soybean meal $120/ton.

These costs also include an advantage given to normal corn for the slight increase in average daily gain and for the added feed necessary to produce equal gains from pigs consuming both types of corn. Price per cwt and not price per bushel was used to compare the two corns, since there is some indication of a possible reduction in test weight for high lysine corn. Therefore the conversion of price/cwt to price/bushel would depend upon the test weight of the high lysine corn.

On the Other Hand . . .

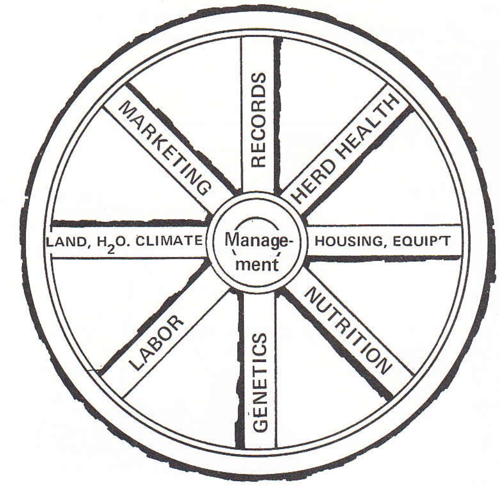
The increased economic value of high lysine corn will vary somewhat depending upon the price of soybean meal. If soybean meal could be bought for less than $120/ton, the economic advantage of high lysine corn would be reduced. On the other hand, if soybean meal continues to increase in price the economic advantage of high lysine corn would be improved even more.

This research clearly shows the increased nutritive and economic value of high lysine corn. But the big question about yield remains. However, several seed corn companies are continually working to produce varieties suitable for this area.

Summary

Results of this trial would indicate that when high lysine corn is used as the major feed grain for swine, the dietary protein level can be reduced by 2% during both the growing and finishing phases without any detriment to performance with possibly an improvement in feed conversion.

It was also observed that when the price of normal corn was considered to be $2.00/cwt and soybean meal $120/ton, the value of high lysine corn was $2.28/cwt when fed in meal form and $2.36/cwt when fed as a pellet. This economic advantage is due primarily to the lower amount of supplemental protein needed in high lysine corn diets and to improved feed conversion.



Superior Management=Profits

Keith E. Gilster
Extension Specialist
(Livestock Development)

Management is hard to define. Proper management is the unique ability of an operator to conduct his swine enterprise successfully and profitably. A good manager is the center of the swine operation. His success and profit will depend on his method of combining resources and skills to produce a product.

A good swine manager:

1. *Uses* genetic material (lines, breeds, individuals) in a breeding program that allows the swine herd to have:
   a. High reproductive efficiency.
   b. Fast growth rate.
   c. High feed efficiency.
   d. High carcass merit.
2. *Possesses* a sound swine herd health program.
   a. Minimizes animal, human, bird and equipment traffic into operation.
   b. Practices a swine disease and parasite prevention and control program.
   c. Recognizes that antibiotics do not substitute for good management.
3. *Follows* a practical swine nutrition program. Feeds diets that will maximize profit through high reproductive efficiency, fast growth rate, high feed efficiency and high carcass merit.
4. *Studies* carefully the advantages and disadvantages of swine equipment and facilities before deciding if he should substitute labor for housing and equipment, or housing and equipment for labor.
5. *Markets* pigs where it allows him the most net return for his product.
6. *Observes* advantages and disadvantages of his swine enterprise.
7. *Keeps* accurate records—which help him find where he can improve his swine enterprise.
8. *Devotes* time and attention to details of the swine operation. Example—farrowing.

It is the manager's decisions that determine the fate of his swine operation. A good swine manager must realize that the largest factor affecting the profit of his swine enterprise is *the number of pigs marketed per female exposed to the boar.* All factors that influence this trait must be closely evaluated. He must be able to recognize the ability of himself and co-workers as "swine men." When key decisions are needed, he must make them.

This is a partial list of the characteristics of a good swine manager. A good manager recognizes good management. He is the hub of the swine production wheel as shown in Fig. 1. Superior swine management is a challenge but it offers sound rewards.

Antibiotic Palatability

Murray Danielson
Associate Professor, Animal Science
(Swine)

This study was started to determine the preference of pigs for a basal diet containing no drug ingredient compared to the same diet fortified with five pounds per ton of CSP.250 (chlortetracycline 20 gm/lb, sulfathiazole 20 gm/lb and penicillin 10 gm/lb) when both feeds are offered free choice.

Procedure

Two groups of pigs, 24 light and 24 heavy weaners, were used in this study. The pigs from each group were alloted to four replicates (three gilts and three barrows per pen) for a total of eight pens. Each pen was comparable in space, automatic waterers and self-feeders.

The two feeders in each pen were in a "neutral" location so that the pigs had no reason to select one feed over the other due to the location factor. The basal diet was placed in one feeder of each pen. The basal diet fortified with five pounds per ton of CSP.250 was placed in the second feeder of each pen. The feeders within each pen were rotated twice weekly.

Weekly feed consumption was recorded for each of the two feeds from each of the eight pens. A basal starter diet used at the North Platte Station was fed each group for the

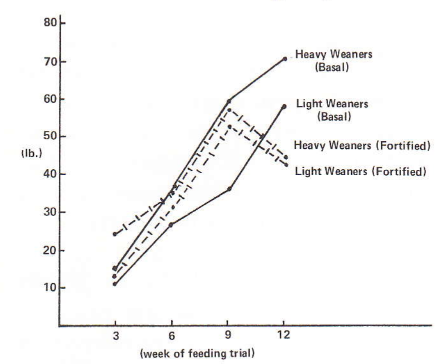


Figure 1. Relationship of basal and basal plus CSP.250 feed intake for light weaners and heavy weaners for three-week interval (Av/pig).

Table 1. Light and heavy weaner pig performance.

Item	Light weaners	Heavy weaners
No of pigs	24	24
No of pigs/pen	6	6
Initial wt, lb	14.6	21.9
Av daily gain/pig 1-3 weeks	0.30	0.80
Feed conversion 1-3 weeks	3.72	2.36
Av daily gain/pig 4-6 weeks	1.02	1.46
Feed conversion 4-6 weeks	2.71	2.35
Av daily gain/pig 7-9 weeks	1.62	1.97
Feed conversion 7-9 weeks	2.62	2.82
Av daily gain/pig 10-12 weeks	1.92	2.20
Feed conversion 10-12 weeks	2.52	2.48
Duration of study, days	84	84

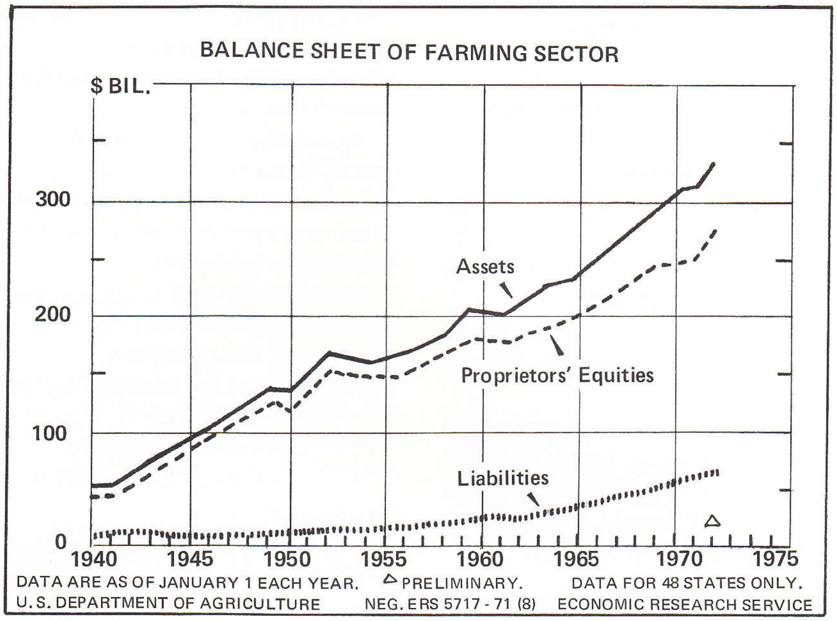
first six weeks, then a grower diet replaced the starter for the remaining six weeks of the 12-week study. All pigs were weighed at three-week intervals throughout the study.

Performance data for the light and heavy weaner pigs used in this study are shown in Table 1. The poor feed conversion at the beginning of this study can be attributed to feed wastage, as the pigs appeared to sort the feed and, as a consequence, waste it. Graphically, Fig. 1 indicates the avenue of preference of the two feeds for the 12-week experimental study.

Average individual three-week total feed intake of the basal and fortified diets are shown in this graph. During the first six weeks the heavy weaners preferred the fortified diet. After six weeks on test they preferred the basal diet. The light weaners also preferred the fortified diet initially but changed preference after about 10 weeks. As is shown on the graph, the pigs appeared to change preference at a commen weight or age.

Summary

In the palatability/preference study discussed, it would appear the preference for the fortified diet (CSP.250) had a duration which terminated at both about the same age and weight of the pigs, disregarding the influence of light vs heavy weaners.



Life Blood of Swine Enterprise

Capital for Pork Production

W. T. Ahlschwede

Extension Livestock Specialist (Swine)

Capital is the lifeblood of any businesss enterprise. In recent years agriculture has been increasingly aware of the need for and the use of large amounts of capital. Consolidation and specialization on Nebraska farms, along with rising real estate values, have caused tremendous increases in per farm capital needs. This is evident by both increased net worth and increased debt levels per farm. Nationally, farm assets increased 50 percent during the 60's (Figure 1).

Pork producers faced with the need to modernize and expand to remain competitive have sometimes been frustrated in their attempts to secure the necessary additional financial backing. However, reports from financial institutions indicate capital is available in the system to provide adequate financing for sound agricultural investments. If the capital needs for pork production expand during the 70's as they did during the 60's, all segments of the industry, lenders, producers and suppliers, will have to become more skillful in finding and managing money.

A farmer with expanding capital needs has many sources of capital available. His ability to choose the best type of institution to supply financing will be a key factor in the ease with which he obtains and manages his capital.

This article describes many of the sources of capital available to farmers and pork producers.

Commercial Banks

Services Provided: Checking and savings accounts, installment loans, short and intermediate loans, advice and guidance.

Source of loanable funds: Deposits, correspondent banks, Federal Reserve Banks and bank capital.

Agricultural loan types: Operating (1 year or less), intermediate (1-5 years) and occasionally long-term loans of over 5 years duration.

Limitations: Nonagricultural loans may be more attractive; reserve requirements limit total loanable funds and loan limits to an individual based upon percent of bank's capital; loan demands increasing faster than deposits.

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Capital for Production

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Production Credit Associations (PCA)

Services provided: Short- and intermediate-term loans (1-7 years).

Source of loanable funds: Sales of debentures on open market, capital stock and earnings.

Agricultural loan types: Short-term operating (1 year or less), intermediate (1-7 years).

Limitations: Borrower must purchase stock in PCA. Loans in excess of 30% of local associations capital must have Federal Intermediate Bank approval.

Farmers Home Administration (FHA)

Services provided: Short-, intermediate- and long-term loans (up to 40 years). Loan guarantees.

Source of loanable funds: Congessional appropriations, other lenders as insured or guaranteed loans, emergency and revolving funds.

Agricultural loan types: Short-, intermediate- and long-term loans.

Limitations: Available to farmers who have exhausted other sources of credit, may lend up to 100% of value.

Producers Livestock Credit Corporation

Services provided: Short-term loans (1 year) to finance livestock purchases (loans extendable to allow orderly marketing).

Source of loanable funds: Federal Intermediate Credit Bank which sells debentures on open market.

Agricultural loan types: Short-term (1 year but extendable) to finance breeding stock.

Limitations: Loan up to 65-75% of value. First lien required on loans.

Merchants and Dealers

Services provided: Arrange credit for purchases.

Source of loanable funds: Sell time-purchase agreements, borrow from supplier, distributor or manufacturer and business capital, sale of commercial paper, captive finance company.

Agricultural loan types: Sales contracts, usually short-term loans on machinery, operating supplies, lease arrangements on stock, buildings and equipment.

Limitations: Need cash income to operate business (can't operate only on credit), financing available only on items sold or handled by firm.

Insurance Companies

Services provided: Long-term, low-service loans.

Source of loanable funds: Money held to meet policy payoff, company capital.

Agricultural loan types: Real estate loans up to 30 years, loans for improvements when secured by mortgages.

Limitations: Compete with other investments, not interested in short-term loans requiring extensive service, selective in areas where loans are made.

Federal Land Bank Associations

Services provided: Long-term loans, usually real estate or permanent improvements.

Source of loanable funds: Public sales of bonds, association capital and earnings.

Agricultural loan types: Long-term (up to 40 years) real estate loans, improvements secured by real estate mortgage.

Limitations: Applicant must be involved in farming, appraisals and loan limits based on standards set by Federal Credit Administration according to criteria established by congressional action, borrower must purchase FLBA stock equal to 5% of loan.

Individuals

Individuals with money to invest may want to loan their money directly rather than through an institution. Real estate contracts are one type of loan. Personal loans not secured by property are also examples.

Small Loan Companies

Small local loan companies may make agricultural loans for operating capital or for short-term purchases.

Most commercial farmers during the 70's will utilize at least two of the types of financial aid listed above. Operating loans and real estate loans are usually handled by different institutions. Many farmers may turn to a third source to help meet intermediate length needs.

As an example, the real estate might be financed by a long-term insurance company loan, production facilities to be paid out over a seven-year period financed by an intermediate-term loan from a Farm Credit System agency and operating capital handled with a commercial bank.

Competition for Loanable Funds

Some financial institutions which have traditionally financed agriculture also serve other groups of people. Commercial banks serve a much broader clientele than agriculture. Commercial banks do make agricultural loans but they also make loans to homeowners for improvements, businessmen to cover inventory, contractors for building and drivers to buy cars. Since banks usually are not able to make all the loans they have applications for, they choose which requests to back and which to turn down.

The bank has to consider the risks in all investments and must protect its depositors. A pork producer seeking a loan must consider other loan applicants as competition. Increasingly, he must be prepared to meet the competition. He must be able to talk the banker's language. The banker may have knowledge and interest in production agriculture but his basic language is dollars and cents, cash projections and budgets.

Car loans are made with an exact pay-back schedule and easily marketable collateral. Business loans are made on detailed cost and return projections and marketable collateral. Building loans

to contractors are based upon construction contracts and well defined pay-out and pay-back schedules. To meet the competition, requests for agricultural loans will need to be backed with similar data.

Other things being equal, a producer who approaches a loan with cash projections showing both need and pay-back schedules, production cost budgets and records of previous performance will receive much stronger backing. He can compete effectively in the money market. The producer who borrows on his good name and good intentions will find increasing difficulty expanding his financial backing.

Putting it Together

Changes in the need for agricultural capital have been paralleled by changes in the financial community. Cooperation among institution types is replacing jealousy. Necessity for broader capital support of large units has fostered this cooperation. In some cases the threat of outside capital has encouraged local institutions to join together to meet the needs of expanding local production.

One of the signs of the changing financial structure is the emergence of the PCA's as a major source of agricultural credit. Between 1950 and 1970, the PCA's increased their share of institution debt in Nebraska from 7.4 percent to 18.8 percent. Nationally, PCA accounts reached 28.4 percent in 1970 and have unlimited potential for expansion.

New legislation under the "Rural Development" label may also change some of the traditional lending channels as regulations come forward. The consolidated Farm and Rural Development Act of 1972 allows FHA to guarantee loans by other agricultural lenders. This would apply to both short and intermediate type loans for stock, facilities and operating capital. The limitations applicable to the lender would still be in force but the FHA guarantee would provide extra security for the loan.

The pork production industry in Nebraska currently has resources available to strengthen its position economically. The profit potential is great enough that "outside interests" may soon be attracted. In gearing up to use available resources, pork producers must make a strong case for increased financial backing if they are to receive it. They must also use good judgment as they plan.

Modernization of pork production facilities often involves in large measure a substitution of capital for labor. Producers must make these changes consistent with their abilities and consistent with profitable production. Some of the skills needed in a mechanized system are different than those in traditional systems. The producer must be prepared for the change.

The producer should seek help in planning for changes. He should seek out facts, opinions and judgments while reserving decisions for himself. Only when *he* makes the decisions is *he* able to manage his capital effectively.

Capital *is* available for pork production for those who can use it effectively and can show that they can use it effectively. Unfortunately, examples exist where too much capital was available. Appropriate financial planning and use of business management techniques makes the acquisition of capital for pork production easier for those who need further backing. Good planning also helps avoid over-extending commitments. The financial community recognizes the profit potential in the pork enterprise and is prepared to back those who can show a sound program.

Confinement Swine Housing—An Update

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Winter-oriented swine housing and management studies for growing-finishing pigs at the Northeast Station have resulted in several important findings. One is that a modified open-front (MOF) building will support performance (gain and feed efficiency) at least equal to an environmentally regulated (ER) building.

An MOF building is one that is all under roof but has the south side open or closed, depending upon the weather. It also has doors on the north side for summer cross ventilation.

An ER building is one that is insulated, mechanically ventilated and supplementally heated.

An MOF building generally costs from $1.50 to $2.50 less per square foot than an ER building.

A summary of research at this Station on effect of housing systems on gain and feed/lb gain is shown in Table 1.

Data in Table 1 are the result of studies conducted primarily during the winter months—a potentially production-limiting period of the year. This clearly indicates that an MOF building will support maximum performance and that the more expensive ER building cannot be justified on the basis of gain and feed to gain ratio.

Table 1. Effect of two housing systems on gain and lb feed/lb of gain.[a]

	MOF	ER
Average daily gain, lb (ADG)	1.62	1.60
Lb feed/lb of gain	2.90	2.89

[a] Pooled data from seven studies and 1440 pigs.

Another important finding is the effect of percent slatted floor on gain and feed to gain ratio (F/G).

Table 2. Effect of percent slatted floor on ADG and F/G.[a]

Percent slats	100	75	50	25
ADG, lb	1.62	1.61	1.63	1.61
F/G	2.94	2.93	2.87	2.84

[a] Pooled data from seven studies and 1440 pigs.

Investigations, again during winter months, have shown that as the amount of slatted floor increases

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Confinement Housing

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the feed requirement per unit of gain also increases. From a practical standpoint we have reported that 25% slatted floor is inadequate due to the corresponding limited pit capacity. We conclude that from one-third to one-half slatted area is optimum. While F/G was influenced by percent slatted floor, daily gain was not.

Summer Research

The effect of season and housing system on swine productivity is fundamental to the return on the investment. Winter-oriented studies clearly show MOF buildings equal to ER buildings.

Next question: "What level of performance could be expected from the same buildings in the summer?"

To answer this question 240 pigs of the same genetic background were used, with 120 assigned to each of two buildings, building B, an MOF house, and building D, an ER house. Allotment was based on weight, sex and litter. Pen dimensions were 6 x 16 feet with the feeder at the upper end of each pen and the waterer at the lower end. Each building has 12 pens, three each of 25, 50, 75 and 100% slatted floor. The study, begun June 4, ended September, 1971. Results are shown in Table 3.

The pigs in the MOF building gained 5 percent faster than those in the ER building. Since the pigs were slaughtered at a common time, rather than a common weight, it appears that the pigs in the ER building were slightly more efficient. However, when the final weight of the pigs in the ER building is adjusted to equal the weight of the pigs in the MOF building, the advantage in feed efficiency is in favor of the MOF unit. In addition to supporting better gain and feed efficiency, the MOF building also required less utility usage, as the ventilation system in the ER building had a charge of $51.16 when assessed at a rate of 2¢ kwh.

Table 3. Effect of two housing systems on ADG and F/G.

	Bldg. B MOF	Bldg. D ER
ADG, lb	1.63	1.55
F/G	2.93	2.89
Adjusted F/G	2.93	3.00

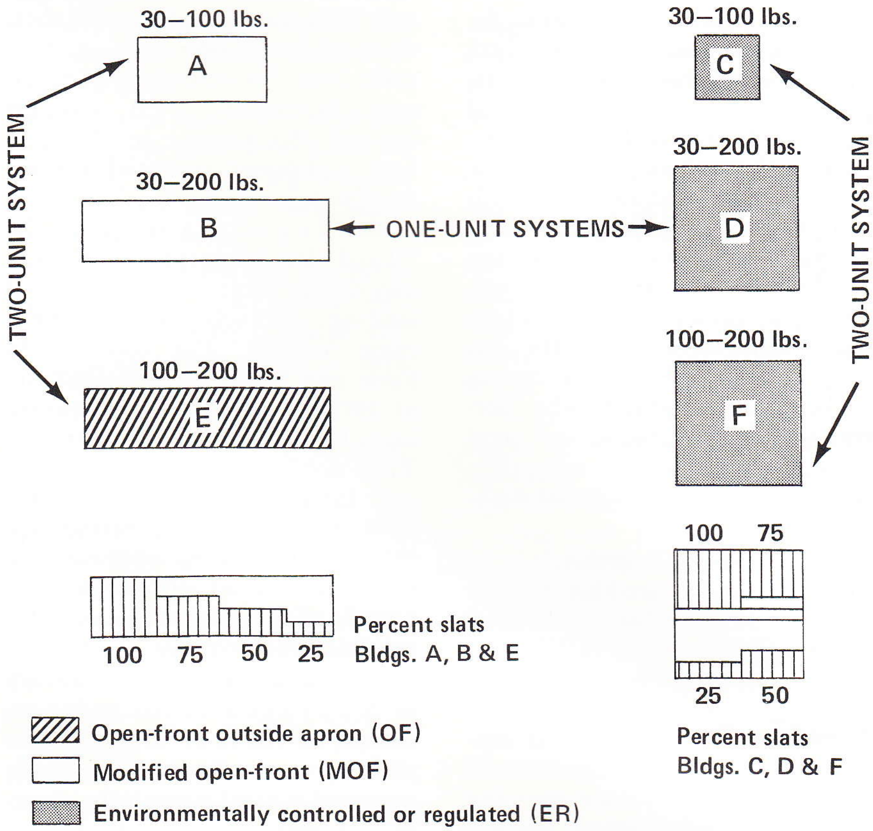

Figure 1. Schematic diagram of housing system.

Economy of Space

A study involving six buildings was conducted during the summer of 1972 to again evaluate the effects of housing and percent slats on gain and feed efficiency. In addition, a comparison was made between a one-unit and a two-unit system.

Since the general space requirement per pig is 4 square feet up to 100 pounds and 8 square feet from 100 pounds to market weight, the one- versus two-unit comparison is largely an economy of space study.

The two-unit ER comparison involved buildings C and F. The two-unit MOF/OF comparison involved buildings A and E. While building A is an MOF building, building E is referred to as an open-front (OF) building since it is onlyl partly under roof. The one-unit comparison was made between buildings B (MOF) and D (ER).

Figure 1 is a schematic diagram of the housing system. Pens in buildings A and C are 4 x 12 feet while pens in all other buildings are 6 x 16 feet. Thus, during Phase 1 the pigs in buildings A and C had only half as much area as the pigs in B and D.

A total of 432 pigs were assigned —nine per pen—based on weight and sex. Data are summarized as Phase 1 and Phase 2. Phase 1 began May 19 with an average pig weight of 21.1 pounds and ended July 20 with an average weight of 105.7 pounds.

When Phase 1 was over, the pigs were moved from building A to building E and from building C to building F, one pen at a time, by means of a portable pen. The entire transaction took about one

Table 4. Effect of housing system and percent slats on ADG.

	Phase 1 [a] [b]				
% Slats	100	75	50	25	Av
Building/System					
Bldg. B, 1 unit, MOF	1.39	1.39	1.37	1.39	1.38
Bldg. D, 1 unit, ER	1.38	1.38	1.39	1.36	1.38
Bldg. C-F, 2 unit, ER	1.37	1.35	1.34	1.34	1.35
Bldg. A-E, 2 unit, MOF/OF	1.33	1.35	1.33	1.33	1.34
Av	1.37	1.37	1.36	1.35	

[a] May 19-July 20, 1972

[b] Av bg wt = 21.1 lb, av final wt = 105.7 lb.

hour per building. The pigs in the two one-unit buildings, B and D, were not disturbed.

Phase 2 began July 20 at an average pig weight of 105.7 pounds and ended on Sept. 22 at an average pig weight of 205.2 pounds.

Table 4 summarizes the effect of housing system and percent slats on average daily gain for phase 1.

An Area Function

Pigs in the one-unit systems (B and D) gained at the same rate but faster than pigs in either two-unit system (A-E and C-F). This difference in growth rate appears to be a function of area since the pigs in A and C had 50% less area. However, the area per pig in A and C was 5.3 square feet—which is considered adequate, if not excessive.

Previous studies comparing the same buildings, but during the winter resulted in building A supporting the best gain and feed efficiency for Phase 1. This strongly suggests a seasonal effect that is important in terms of the early research for it shows that an MOF building, when properly managed, can support excellent performance among small pigs.

The effect of amount of slatted floor on ADG for Phase 1 suggested a slight linear relationship as gain trended higher with increased amount of slatted floor. Past research has shown little if any effect of amount of slatted floor on ADG.

The effect of housing system and percent slatted floor on F/G is shown in Table 5.

The average F/G for the one-unit systems is slightly greater than for the first components of the two-unit systems. However, since the pigs were weighed off Phase 1 at a common time rather than a common weight, the difference in F/G is misleading. If the F/G averages were adjusted to a common weight there would be a very slight advantage in favor of the one-unit systems.

This difference is shown more realistically when Phases 1 and 2 are combined in Table 9. The effect of percent slats on F/G for Phase 1 shows a trend toward an increase in feed required per unit of gain. This is similar to the results of earlier winter studies we have reported. However, it should be again repeated that while 25% slatted flor supports optimum F/G, it does not provide adequate pit capacity for liquid manure storage.

Table 6 summarizes the effect of housing systems and percent slats on ADG for Phase 2.

Pigs in the one-unit MOF building/system B outgained all others during Phase 2. Perhaps the most significant information generated from Phase 2 is the depressing effect of building E on gain. This building has been described as an open-front house. And, while winter studies have shown it to be totally inadequate when compared to an MOF or ER building, it was generally felt that it would support nearly optimum performance during the summer. Apparently this type of building does not provide enough protection from the elements to support desired performance regardless of the season.

Slightly Faster

When comparing ADG between building C and D for Phase 1, the pigs in building D gained slightly faster. However, when comparing ADG between F and D for Phase 2 when the pigs were moved from C to F for Phase 2 the two-unit C-F pigs made enough recovery in ADG to catch up (1.60 lb/hd/day for the one-unit system versus 1.61 lb/hd/day for the two-unit system).

Most of this recovery for the two-unit system was made the first two weeks after the pigs moved from building C to F. Thus, in this case it appears the actual move had a short term beneficial effect. The same was not true, how-

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Table 5. Effect of housing system and percent slatted floor on F/G.

	Phase 1 [a] [b]				
% Slats	100	75	50	25	Av
Building/System					
Bldg. B, 1 Unit, MOF	2.71	2.66	2.71	2.58	2.66
Bldg. D, 1 Unit, ER	2.61	2.69	2.58	2.66	2.64
Bldg. C-F, 2 Unit, ER	2.60	2.65	2.62	2.64	2.63
Bldg. A-E, 2 Unit, MOF/OF	2.60	2.62	2.69	2.57	2.62
Av	2.63	2.66	2.65	2.61	

[a] May 19-July 20, 1972.

[b] Av bg wt = 21.1 lb, av final wt = 105.7 lb.

Table 6. Effect of housing system and percent slatted floor on ADG.

	Phase 2 [a] [b]				
% Slats	100	75	50	25	Av
Building/System					
Bldg. B, 1 Unit, MOF	1.66	1.67	1.69	1.65	1.67
Bldg. D, 1 Unit, ER	1.58	1.59	1.65	1.56	1.60
Bldg. C-F, Unit, ER	1.59	1.64	1.63	1.58	1.61
Bldg. A-E, 2 Unit, MOF/OF	1.54	1.45	1.53	1.56	1.52
Av	1.59	1.57	1.62	1.57	

[a] July 20-Sept. 22, 1972.

[b] Av bg wt = 105.7 lb, av final wt = 205.2 lb.

Confinement Housing

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ever, for pigs moved from building A to building E.

The effect of percent slats on ADG for Phase 2 was without pattern. However, it is worth noting that the 50% slatted floor supported the most rapid gain.

The effect of housing system and percent slatted floor on F/G for Phase 2 is shown in Table 7.

The average F/G summary for Phase 2 shows that the MOF building B supported the best performance. Differences in F/G between the other building/systems was slight. The effect of percent slatted floor on F/G for Phase 2 showed considerable variation. While the 25% slatted floor supported the best F/G for Phase 1, the reverse was true for Phase 2. The cause for this reversal is not clear. Indeed, there is no pattern at all when comparing the effect of percent slatted floor for Phase 2.

Phase 1 and 2 Combined

When pooling Phase 1 and 2 data the effect of building/system and percent slatted floor on ADG is shown in Table 8.

The results show that building B, the one-unit MOF building/system, supported the most rapid gain. The data also show that the ADG was identical between the one- and two-unit ER housing/system. The pooled data also show that the two-unit MOF/OF building/system supported the slowest gain. Combined with the previous winter tests, the summer tests provide a strong case for the recommendation of the MOF type building as the "optimum" for growing-finishing swine.

The result of percent slatted floor on ADG is without pattern. This is in agreement with previous results which were shown in Table 2.

Table 9 shows the pooled results of Phase 1 and 2 for F/G.

The results show that building B, the one-unit MOF building/system, had a slightly lower feed requirement per unit of gain. There was essentially no difference in F/G between the other building/systems.

The overall or combined effect of percent slatted floor on F/G indicates little difference. It is interesting to note that the 100% slatted floor had the lowest feed requirement per unit of gain. While the difference is slight, this is the reverse of the winter data. This suggests that the totally slatted floor may be cooler in the summer—which benefits F/G. However, in the winter the opposite may be true since the feed requirement per unit increases.

Pigs Might Let You Know

The justification for greater building costs must be based upon greater expected returns. Hopefully, confinement pork production will allow the pig to more nearly express its optimum genetic ability to perform. It is important to know that different types of confinement support different levels of performance. Stated another way—sophistication of design and greater attempts at environment control are not synonymous with improved performance. Or, what looks good to you may not look good to the pig.

Table 10 summarizes the profit per pig by building system for the previous study involving 432 pigs.

Table 10 shows that building B, the one-unit, MOF building/system, returned the greatest net profit per pig. The lowest returns were obtained in the two-unit MOF/OF building/system. Again, the difference in profit per pig per building/system is a reflection of F/G and/or ADG. Thus it is not only misleading but inaccurate to assume that all forms of confinement support the same level of performance. The net profit per pig assumes additional significance when the initial cost per square foot of building is considered.

Table 9. Effect of building/system and percent slatted floor on F/G.

% Slats	100	75	50	25	Av
Phase 1 and 2 Combined[a]					
Building/System					
Bldg. B, 1 Unit, MOF	3.18	3.17	3.25	3.18	3.19
Bldg. D, 1 Unit, ER	3.18	3.31	3.21	3.35	3.26
Bldg. C-F, 2 Unit, ER	3.23	3.29	3.22	3.22	3.24
Bldg. A-E, 2 Unit, MOF/OF	3.24	3.31	3.28	3.20	3.26
Av	3.21	3.27	3.24	3.24	

[a] May 19-Sept. 22, 1972. Bg wt = 21.1 lb, final wt = 205.2 lb.

Table 7. Effect of housing system and percent slatted floor on F/G.

% Slats	100	75	50	25	Av
Phase 2 [a] [b]					
Building/System					
Bldg. B, 1 Unit, MOF	3.66	3.68	3.80	3.79	3.73
Bldg. D, 1 Unit, ER	3.75	3.93	3.85	4.05	3.90
Bldg. C-F, 2 Unit, ER	3.86	3.94	3.82	3.80	3.86
Bldg. A-E, 2 Unit, MOF/OF	3.89	4.00	3.88	3.83	3.90
Av	3.79	3.71	3.84	3.87	

[a] July 20-Sept. 22, 1972.
[b] Av bg wt = 105.7 lb, av final wt = 205.2 lb.

Table 8. Effect of housing system and percent slatted floor on ADG.

% Slats	100	75	50	25	Av
Phase 1 and 2 Combined[a]					
Building/System					
Bldg. B, 1 Unit, MOF	1.52	1.53	1.53	1.52	1.52
Bldg. D, 1 Unit, ER	1.48	1.48	1.52	1.46	1.48
Bldg. C-F, 2 Unit, ER	1.48	1.49	1.48	1.46	1.48
Bldg. A-E, 2 Unit, MOF/OF	1.43	1.40	1.43	1.44	1.42
Av	1.48	1.47	1.49	1.47	

[a] May 19-Sept. 22, 1972. Bg wt 21.1 lb, final wt = 205.2 lb.

Table 10. Effect of housing system on pig profit.

Bldg.	MOF 1-Unit B	ER 1-Unit D	ER 2-Unit C-F	MOF/OF 2-Unit A-E
Income[a]	$5671.96	$5576.76	$5547.64	$5407.64
Feed cost[b]	2359.22	2369.66	2352.42	2300.26
Difference	$3312.74	$3207.10	$3195.22	$3107.38
Feeder pig costs[c]	1836.00	1836.00	1836.00	1836.00
Difference	$1476.74	$1371.10	$1359.22	$1271.38
Utility costs[d]	....	45.32	36.06	....
Difference (balance)	$1476.74	$1325.78	$1323.16	$1271.38
Net profit per pig	$ 13.67	$ 12.28	$ 12.25	$ 11.88

[a] Assumes market price of $28 cwt for 108 pigs for all systems except A-E which had 107.
[b] Assumes feed costs of 3.6¢ lb.
[c] Feeder pig costs of $17 head.
[d] Utility costs of 2¢ kwh.

Building	*Cost/Sq. Ft.*
E	$4.82
B	5.16
A	5.58
D	7.74
F	7.74
C	8.68

It is worth noting that building D cost $2.58 per square foot more than building B—yet in this study, building B returned $1.39 more per pig than building D. Other similar cost comparisons can and should be made by producers prior to making the decision—which building for me?

Summary

1. Higher priced environmentally regulated growing-finishing units are not necessary for optimum returns since the modified open-front unit allows the pig to more nearly perform at the peak of its genetic ability.

2. The modified open-front building concept will allow the producer to enjoy the technology of confinement production at a modest cost.

3. In general, the one-unit system appears superior to the two-unit system even though the efficiency of space utilization in the one-unit system is lower during Phase 1. It appears that the two-unit system could work for the exceptional manager, asuming the all in-all out practice.

4. The overall data for the past four years indicate that for best year around performance, a slatted area of from one-third to one-half is best.

Infectious Arthritis in Swine

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There are four general causes of swine arthritis: nutrition, disease, inheritance and environment-management. Two or more of these factors may be operating at once, making diagnosis difficult.

Infectious Arthritis

The five most important infectious agents involved in swine arthritis are streptococci, *Corynebacterium pyogenes,* Erysipelothrix, *Mycoplasma hyorhinis* and *Mycoplasma hyosynoviate.* Other bacteria are sometimes isolated from arthritic joints but are usually individual pig problems.

These agents commonly affect pigs at certain ages. Table 1 shows the ages at which the five may be expected to cause arthritis.

Table 1. Agents in infectious arthritis.

	3 weeks Birth to	3-10 weeks	10-20 weeks	Adult
Streptococcus	x			
Corynebacterium pyogenes	x		x	x
Erysipelothrix		x	x	
Mycoplasma hyorhinis		x		x
Mycoplasma hyosynoviae			x	x

A survey of bacteria isolated from arthritic swine joints showed that in pigs of less than market weight, the following percentages of these infectious agents were found: mycoplasma, 21%; erysipelothrix, 2%; streptococcus, 14%, and corynebacterium, 6%.

In animals market weight and over the following percentages were found: mycoplasma, 2%; erysipelothrix, 25%; streptococcus, 19%, and corynebacterium, 6%.

No infectious agent was found in nearly 50% of the arthritic joints examined. Arthritis was often caused by an infectious agent that had been eliminated but clinical signs and lesions of arthritis remained. A few of these cases may be due to trauma (injury).

Streptococcal Arthritis (Navel Ill)

Clinical Signs (Symptoms)

1. Most frequent in pigs one to three weeks old.
2. Rough hair coats.
3. Fever.

Figure 1. Pig joint with streptococcus arthritis caused by navel ill.

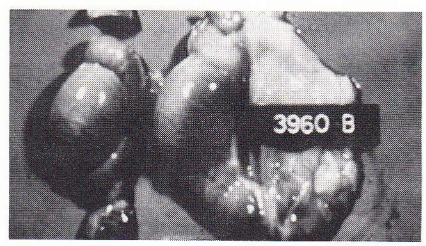

Figure 2. Orchitis caused by *Mycoplasma hyorhinis* infection.

4. Loss of appetite.
5. Lameness.
6. Joint swelling (Figure 1).

Prevention and Treatment

1. Eliminate carrier sows by feeding high levels of antibiotics for 5-6 weeks, preferably before breeding.
2. Good sanitation.

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Infectious Arthritis

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3. Depopulate and purchase clean breeding stock.
4. Tie off navel cords and dip stumps in tincture of iodine.
5. Protect carpal joints (knees) of pigs from being abraded on rough floors (Tabor trim cement can be applied to skin over knee joint).
6. Treatment – repeated injections of antibiotics. Results are disappointing if treatment is not given in acute stages.

Mycoplasmal Arthritis (formerly called PPLO)

Mycoplasma hyorhinis

1. Arthritis and polyserositis in 3-10 week old pigs.

Clinical Signs or Symptoms

1. Abdominal pain, labored breathing.
2. Inflammation of testicles (Figure 2).
3. Temperature 104-107°F.
4. No coughing or sneezing.
5. Arthritis.

Mycoplasma hyosynoviae

1. Arthritis in hogs 80 lb. to market weight. Also in young breeding gilts and boars (Figure 3).

Clinical Signs or Symptoms

1. Most frequent and more severe in heavily muscled swine.
2. Stress is a predisposing factor.
3. Sudden onset of lameness in one or more legs.
4. Not much joint swelling.
5. Acute stage lasts 3 to 10 days.

Both mycoplasmas are commonly found in tonsils or respiratory tract of carrier animals. Stress or the presence of other diseases predisposes to the development of arthritis. This type of stress often occurs in young boars when they are moved to new premises.

Figure 3. Mycoplasmal arthritis caused by *Mycoplasma hyosynoviae* infection.

Figure 4. Arthritis caused by chronic swine erysipelas.

Control and Treatment

1. Purchase clean breeding stock.
2. Prevent stress.
3. Allow breeding stock time to adjust to location and contacts.
4. Separate lame pigs and treat 3-4 consecutive days with injectable antibiotics.
5. Feed and water types of antibiotics are not effective.

Erysipelas Arthritis

1. The erysipelas organism can survive in soil for about 20 days.
2. Healthy carrier swine shed the organism in feces.
3. Susceptible pigs pick up the organism.
4. Acute or chronic disease may result.

Clinical Signs or Symptoms

1. Chronic arthritis in pigs 10 weeks old or older.
2. Joints enlarged and hard due to excessive connective tissue production (Figure 4).
3. Knee and hock joints commonly affected.
4. Temperature usually normal.

Control and Treatment

1. Bacterins or vaccines given to sows 30 days before breeding and repeated 3 weeks before farrowing.
2. Bacterins or vaccines given to pigs at 7-8 weeks of age, after weaning.
3. May have to repeat pig vaccination at 100 to 125 lb on problem farms.
4. Treatment—Antibiotics injected during very early stages are effective. Treatment is disappointing if joint damage has already become extensive. Anti-erysipelas serum given in conjunction with antibiotics may give better results than antibiotics alone.

Traumatic (injury) Arthritis

Arthritis caused by trauma (injury) to joints from confinement on concrete floors may be confused with erysipelas or mycoplasmal arthritis. Traumatic arthritis is more common in heavily muscled swine and certain genetic strains.

Summary

Five important organisms cause swine arthritis. These organisms usually affect pigs at the age groups indicated in table 2.

Control of swine arthritis requires definitive diagnosis by a veterinarian.

Susceptibility to some forms of infectious arthritis appears to be genetically controlled. It is, therefore, advisable to inspect all the animals in a herd that is being considered as a source of new breeding stock. Look for animals with a long stride and free and easy gait. Avoid herds that contain animals with short, choppy steps.

Table 2. Organisms that cause swine arthritis.

Organism	*Age Affected*
Streptococci (Navel Ill)	Birth to 3 weeks
Corynebacterium pyogenes	Any age
Erysipelothrix	3 to 20 weeks
Mycoplasma hyorhinis	3 to 10 weeks (adult?)
Mycoplasma hyosynoviae	10 to 20 weeks (adult?)

Feed Grain For G-F Swine

Murray Danielson
Associate Professor, Animal Science (Swine)

Nebraska pork producers are continually challenged to make the best use of their resources. For some, this may mean using feed grains other than corn or milo. Two such grains are rye and triticale. Rye has been produced and available as a feed grain for many years. Triticale is a relatively new feed grain. It is a species of small grain derived from crossing durum wheat and rye.

The studies discussed here were started to determine the feasibility of replacing corn, in part or completely, with either rye or triticale in diets for growing-finishing swine. The triticale used in the diets was grown and harvested by Agronomy researchers at the North Platte Station. The rye was of the Von Lochow variety and produced locally.

Procedure

Study A. Forty-eight crossbred pigs were stratified by weight and sex and randomly allotted to two replicates of four growing-finishing diets. The meal diets (Table 1) were formulated by replacing corn with rye in the basal corn-soy diet at levels of 20, 40 and 60%, respectively.

Study B. Ninety crossbred pigs were allotted as in Study A to three replicates of five growing-finishing diets. The meal diets (Table 2) consisted of the basal corn-soy diet of which the corn was replaced at varying levels with rye (R) or triticale (T) of 75 R, 100 R, 50 T and 100 T, respectively.

Studies A and B. Accommodations for the pigs on each of these studies were comparable. Each pen of six pigs had like shelters, self-feeders and automatic waterers. Each study lasted 98 days.

(continued on next page)

Table 1. Diet composition (Study A).

Ingredients, %	Diet designation 1	2	3	4
Corn	78.20	65.56	46.92	31.28
Rye	....	15.64	31.28	46.92
Base Mix[a]	21.80	21.80	21.80	21.80
Calculated content, %				
Protein	13.81	14.11	14.42	14.72
Calcium	0.67	0.69	0.71	0.73
Phosphorus	0.74	0.74	0.74	0.75

[a] Base mix included (percent of total ration) 44% soybean meal, 15%; alfalfa hay, 2.5%; calcium carbonate, 1.55%; sodium tripoly, 1.75%; iodized salt, 0.5%; trace minerals, 0.075% Calcium Carbonate Company, Swine, 20% Zn); vitamin premix, 0.425%. Vitamin premix contributed the following amounts per pound of complete diet: Vitamin A, 1200 IU; Vitamin D, 135 IU; riboflavin, 2.0 mg; niacin, 9.0 mg; calcium pantothenate, 4.0 mg; choline chloride, 10.0 mg; Vitamin B_{12}, 5.0 mcg.

Table 2. Diet composition (Study B).

Ingredients, %	Diet designation 1	2	3	4	5
Corn	78.20	15.64	....	39.10	....
Rye	....	62.56	78.20	....	....
Triticale	....	....	....	39.10	78.20
Base mix[a]	21.80	21.80	21.80	21.80	21.80
Calculated content, %					
Protein	13.81	15.03	15.33	14.82	15.84
Calcium	0.67	0.67	0.67	0.67	0.68
Phosphorus	0.74	0.60	0.56	0.80	0.86

[a] Base mix included (per cent of total ration) 44% soybean meal, 15%; alfalfa hay, 2.5%; calcium carbonate, 1.55%; sodium tripoly, 1.75%; iodized salt, 0.5%; trace minerals, 0.075% (Calcium Carbonate Company, Swine, 20% Zn); vitamin premix, 0.425%. Vitamin premix contributed the following amounts per pound of complete diet: Vitamin A, 1200 IU; Vitamin D, 135 IU; riboflavin, 2.0 mg; niacin, 9.0 mg; calcium pantothenate, 4.0 mg; choline chloride, 10.0 mg; Vitamin B_{12}, 5.0 mcg.

Table 3. Comparison of corn and rye for growing-finishing swine (Study A).

Treatment	Diet designation 1	2	3	4
	Corn basal	20% rye 80% corn	40% rye 60% corn	60% rye 40% corn
No of pigs	12	12	12	12
No pigs per pen	6	6	6	6
Av initial wt, lb	48	50.7	47	51.1
Av termination wt, lb	214.7	219.6	203	222.7
Av daily gain, lb	1.70	1.73	1.59	1.75
Av daily feed intake, lb	6.29	6.14	6.04	6.96
Feed conversion	3.70	3.56	3.81	4.00
Duration, days	98	98	98	98

Table 4. Comparison of corn, rye and triticale for growing-finishing swine (Study B).

Treatment	Diet designation 1	2	3	4	5
	Corn basal	25% corn 75% rye	100% rye	50% corn 50% T	100 T
No of pigs	18	18	18	18	18
No pigs per pen	6	6	6	6	6
Av initial wt, lb	53.5	52.9	53.4	52.8	53.5
Av termination wt, lb	218.2	209.7	203.6	223.2	219.1
Av daily gain, lb	1.68	1.60	1.53	1.74	1.70
Av daily feed intake, lb	5.70	5.60	5.36	6.04	6.07
Feed conversion	3.41	3.48	3.52	3.47	3.57
Duration, days	98	98	98	98	98

Feed Grain

(continued from page 23)

Results and Discussion

Studies A and B. Performance data are shown in Tables 3 and 4, respectively. As indicated in Table 3, the pigs that consumed diets 1, 2 and 4 revealed about the same average daily gain. However, the pigs fed diet 4 were less efficient as is further indicated by their average daily feed consumption. This could possibly be attributed to the palatability involved when a higher level of rye is used. The pigs that consumed diet 3 indicated the lower average daily gain which in part can be reflected back to the lower average daily intake as indicated in Table 3.

Table 4 indicates daily gain results favoring the incorporation of triticale in growing-finishing diets. However, the increased daily gains did not improve the feed conversion as there were no significant differences among the five diet treatments. Again, there was a reduction in performance of the pigs fed the higher levels of rye.

Summary

One-hundred-thirty-two pigs were exposed to diets each differing in levels of either rye or triticale as a replacement of corn in a corn-soy growing-finishing diet. The lower level of rye replacement diets and all of the triticale diets yielded comparable pig performances compared to the pigs fed the basal corn-soy diet.

A portion of this response could be due to the increased percent protein of these diets as the rye and triticale each contained a greater quantity than that found in corn.

The decrease in performance of the pigs on the higher level of rye could possibly be a result of the decrease in palatability of these diets. Overall it has been shown from these studies that rye and triticale can be successfully used as a replacement for corn in growing finishing swine diets.

Evaluate Your Expansion Plans

Use Cash Flow Analysis

Larry L. Bitney
Extension Economist
(Farm Management)

Whether you're thinking about remodeling or replacing old facilities, expanding your hog enterprise or starting into the hog business, a cash flow analysis may have something to offer you.

Much of what we read and see about cash flow relates to its use as a year-to-year financial planning tool. It is typically used to determine when credit will be needed and when loan payments should be possible in the coming year. This is an important use of cash flow analysis, and one which farmers and lenders will see more of in the future. But the cash flow approach can also be used profitably in evaluating long-term investments.

Cash Flow vs Conventional Budget

A cash flow analysis offers an advantage over the tool which we have commonly used to evaluate a prospective investment, or venture. When asked to evaluate prospective investment we have typically calculated a budget which showed the projected costs and returns.

In calculating the costs, we have usually used a depreciation charge based on a 10-year life of buildings and equipment, an interest charge based on the average investment over the life of the item—and other costs were based on the average conditions over the planning period. Income was typically based on sales which would be occurring at the projected or target level of production. This type of budgeted analysis served, and still serves, a valuable purpose. It shows whether the investment or venture will be profitable, on the average, over the life of the investment.

But in the competitive business you're in today, you need to know more about a prospective venture than if it will, on the average, be profitable over its projected life. If you can't make your way through the first two years, the fact that the eight following years will be better is not important.

The primary advantage a cash flow analysis has over a conventional budgeted analysis is *timing*. A cash flow analysis shows the timing of projected costs and returns. It shows when capital will be needed and when you should be able to recover it. The example in Table 1 shows how you might apply a cash flow analysis to a prospective hog enterprise.

Timing is important, as you usually must pay for a building much faster than you are allowed to depreciate it. Also, other costs such as interest will be highest early in the life of the investment. These factors are ignored in a conventionally budgeted analysis.

Also, as shown in Table 1, there is a lag between the time that money is first needed for construction and the time that the first income is received. This lag could be as long as two years for a person just starting in the business of hog production. Additional time may pass before the target or desired level of production is reached. This time lag is usually ignored in a conventional budget. The cash flow approach treats these critical "early years" of an investment or venture realistically

The Payoff Period Approach

A cash flow analysis will show how long it should take for an investment to pay off.

In contrast, a conventional budget assumed a fixed payoff period, such as 10 years, and we calculated the potential annual profit over that period. The payoff period approach utilized in the cash flow analysis is commonly used in other industries for evaluations of investment alternatives.

Is it a waste of time to pencil out a detailed plan, such as a cash flow analysis? Unfortunately, there are farmers and lenders who believe that it is.

A common argument against doing some pencil pushing is that since we don't know what the costs and prices will be in the future, there is no point in doing any planning on paper. A person who is making only a small investment may not find it worthwhile to develop a detailed plan. A person in a high equity position may not have any trouble getting through the critical, early years of a new venture, and may be able to afford the gamble of an investment being unprofitable.

But the person who must stake his future on the payoff of an investment needs to put together the best information he can get and analyze it to the best of his ability. He will not eliminate all risks when he does this but he will reduce the chance of making a bad decision.

One alternative for dealing with uncertain prices and production

Table 1. Projected cash flows for a 24-sow enterprise.[a]

	1972	1973	1974	1975
Income				
Butchers	....	8,302	16,949	16,949
Cull breeding stock	138	138	720	720
Total cash available	138	8,440	17,189	17,189
Expenses				
Operating Expenses				
Corn	$ 139	$ 3,351	$ 5,036	$ 5,036
Out of pocket costs (commercial feed, vet & med., utilities, marketing, supplies, machinery operation, taxes, etc.)	143	4,311	6,179	6,179
Capital Expenses				
Breeding stock	1,750	....	....	....
Farrowing house	6,000	....	....	....
Finishing house	5,250	....	....	....
½ honey wagon (share with neighbor)	900	....	....	....
Other Expenses				
¼ of family living expense	400	1,600	1,600	1,600
Total Cash Required	$14,582	$ 9,262	$12,815	$12,815
Summary				
Cash available less cash required	(−14,444)	(−822)	+4,374	+4,374
Money to be borrowed	14,444	822	....	....
Debt payments—Principal	....	....	1,974	3,311
Interest	....	....	2,400	1,063
Loan Balance[b]	$14,444	$15,266	$13,292	$ 9,981[c]

[a] Assumptions:
Starting time, fall, 1972.
Two herds of 12 sows each.
Build a 12-sow farrowing house for $6,000.
Building a 150-head finishing house for $5,250.
Use old buildings for sow shelters.
$22/cwt price for market hogs.
One-fourth of operator's time devoted to this enterprise.
7.5 pigs sold per litter.

[b] For simplicity it was assumed that all capital was borrowed for this enterprise. The loan balance shown here is the amount of unrecovered capital, which may or may not be borrowed in an actual case.

[c] Projecting this analysis further, the enterprise "pays off" in 1978, with an excess balance of $1,628. Thus at the end of six years the operator has no debt, facilities with a depreciated value of $5,000, and a hog inventory of $5,100, in addition to realizing a $1,600 labor income from this enterprise each year.

rates is that of testing the effect of different price levels and rates of production. For instance, your basic plan might reflect a market hog price of $22/cwt and a production rate of 7.5 pigs per litter. Then, you might develop alternative plans by substituting in a market hog price of $20 or $24. You might find that you would have to average 7.5 pigs per litter and realize $22/cwt in order to pay for your buildings and equipment in seven years. But if the price were $24, it would take only five years.

Variations in the Use of Cash Flows

A cash flow analysis may be limited to your hog enterprise as is the example in Table 1 or it may include your whole farm business. The nature of your analysis depends upon what questions you have.

An analysis of the hog enterprise only will show the expected payoff of a new investment from earnings of the hog enterprise alone.

A cash flow analysis which includes the whole farm business will show how the added obligations of the swine enterprise will fit in with existing obligations, and whether the total farm business can generate sufficient cash to meet loan payments, family living needs and the capital requirements of other enterprises in the farm business.

A long-term cash flow analysis (2-5 years) such as is shown in Table 1 usually will not take the

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Cash Flow Analysis

(continued from page 25)

place of an annual cash flow plan. An annual cash flow plan should be prepared each January or February and will show projected cash flows in more detail for that year—on a monthly or quarterly breakdown.

A cash flow form, which can be used for either annual or long-term projections, is available to County Extension Offices in Nebraska. Its number is EC 71-852. Two bulletins, EC 71-849 and EC 71-850, are also available to aid you in developing your annual cash flow plan.

What's in It for Me?

In addition to giving you an overall evaluation of a proposed investment, a cash flow plan will give you some guidance on the type of financing you should ask for. If your projections show that it will take seven years to pay for facilities, you may have problems if you can only get a five-year loan. This analysis will also show your supplier of short-term credit what he might expect in terms of credit requirements and payoff.

The cash flow plan aids you in communicating with your lender. He can do a better job as your financial advisor if he has more information. A cash flow analysis "puts it all together." You don't ask for a feed loan one week, a loan to pay a veterinary bill the next week and a loan to cover family living expenses a few days later. Your lender will appreciate seeing an estimate of his total involvement in a venture at the outset, even though the peak credit requirements may not be reached until later.

A cash flow analysis forces you to do some fairly precise planning. The development of the plan will allow you to organize your thoughts and consult others for their opinions. When the plan is developed it can serve as a valuable guide, or benchmark, in managing the enterprise once the investment has been made.

Figure 1. Litter of pigs dead from colibacillosis.

Figure 2. Two-week-old pig with transmissible gastroenteritis.

Baby Pig Scours

R. Gene White

Assistant Professor, Veterinary Science

Baby pig scours is a main cause of economic loss to the swine industry. Not only are many pigs lost but many are stunted if they recover. An accurate diagnosis of the cause is essential to prevent spread to other pigs in the litter. No diagnosis should be made on signs alone. Signs should be tied with postmortem and laboratory findings.

The "normal flora" of swine intestinal tracts consists of about 300 different organisms, most of which are capable of producing some degree of trouble under proper conditions. These organisms serve a useful purpose by stimulating the development of immunity to infection. They also play an important part in the digestive process.

Colibacillosis

Escherichia coli is the predominant bacterial organism in the intestine. Certain strains of *E. coli* are capable of producing diarrhea in pigs. This disease is known as colibacillosis (white scours).

There are three stages in a pig's life when he is more likely to be infected with colibacillosis: 1-4 days, three-weeks-old and weanling. Signs of the disease depend on the age of the pig affected.

When colibacillosis affects pigs during the first few days of life, they become listless and develop a yellowish watery diarrhea. The pigs are usually wet around the tail and back legs. Severe dehydration and a coma develop and pigs die rather rapidly (Figure 1). Generally an entire litter is affected. Other litters close by may not be affected.

It is usually worse in pigs from gilts with their first litter.

In three-week-old pigs, resistance provided by the sow through colostrum is disappearing while pigs are just beginning to build their own resistance. They may be more susceptible to colibacillosis when three weeks old than at any other time in their life. Most pigs may scour at this time, with only a few deaths. However, a costly setback in growth may occur. Do not put additional stress on pigs at this time.

A similar disease condition may occur at weaning when pigs are under stress of changing environment and diet. The balance of bacteria in the gut may be upset and allow a disease-causing strain of E.coli to produce scours.

The diagnosis of colibacillosis can be confirmed by postmortem examination and by studying cultures of bacteria from the intestinal tract. An antibiotic sensitivity test may aid in treatment.

Colibacillosis usually responds to antibiotics if they are given early. During the first three or four days, antibiotics should be injected along with some fluid to prevent dehydration. The entire litter should be treated. This may require treatment for two to three days.

At the three-weeks scours, antibiotics administered orally to the infected pigs are usually most successful. At weaning, antibiotics in feed may be satisfactory.

Vaccines made from the organisms that are producing scours have been used with success.

Transmissible Gastroenteritis (TGE)

TGE is a highly contagious viral disease which results in almost 100% death loss in pigs under ten days of age.

Young pigs vomit, scour and rapidly become dehydrated (Figure 2). The pigs' ability to withstand this increases with age. Pigs 10-30 days of age can sometimes be treated with some benefit. Pigs over 30 days usually survive.

The source of the TGE virus and method of transmission are unknown, making prevention difficult.

Proper management for disease control is very important to prevent infection with TGE. Do not allow visitors in the farrowing house. Don't let cats, dogs and birds get into the farrowing house. Use the "two-boot" system—one pair on the farm and one pair off the farm.

Vaccines have not been very successful in preventing TGE. Deliberate exposure of pregnant sows three weeks before farrowing has been used. This method is dangerous in case other diseases are present but may afford the only means of prevention.

Clostridial Enteritis

Clostridial diarrhea is caused by a *C. perfringens* organism, one that grows in the intestinal tract when conditions are just right. It produces a poison or toxin, which damages the cells lining the intestine and prevents normal absorption of nutrients, including water.

Clostridial diarrhea affects baby pigs primarily during the first week of life. Listlessness and yellow diarrhea which may contain some blood are typical signs. Most affected pigs die within 24-36 hours.

Diagnosis can be made by laboratory analysis. The disease can be controlled by injecting antitoxin into the baby pig within a few hours after birth. In severe outbreaks oral antibiotics may be administered with the antitoxin.

Pregnant sows may be injected with a toxoid during gestation. Injections should be given at 28 days and 14 days before farrowing. Antibodies are then passed through the colostrum to protect the baby pig.

Swine Dysentery (Vibrionic Dysentery)

Vibrionic dysentery may also be found in pigs while they are still nursing. It is usually exhibited by diarrhea, with several of the pigs becoming chronically sick. These pigs are usually stunted. The fecal material usually does not contain blood from the nursing pigs.

Postmortem and laboratory examinations are the means of diagnosis. Treatments used are arsenicals and neomycin. Several new antibiotics show promise.

Summary

A comparison of the four enteric diseases is shown in Table 1.

An accurate diagnosis is important when enteric diseases are encountered. Live sick pigs in different stages of disease should be submitted for postmortem examination. Samples from these pigs should be submitted to a laboratory to confirm diagnostic findings.

Table 1. Summary of enteric diseases in baby pigs.

Name of disease:	Transmissible gastroenteritis (TGE)	Clostridial enteritis	Porcine enteric colibacillosis	Swine dysentery
Disease causing agent:	TGE virus	*Clostridium perfringens,* type C	*Escherichia coli*	Unknown, *Borrelia* sp., *Vibrio coli* and *Treponema* sp. suspected
Seasonal prevalence:	Highest in winter	None	None	None
Transmissibility:	Rapid spread, highly contagious	Slow spread	Very slow spread	Rapid spread
Morbidity:	High	Variable	Moderate	Highest in weaning pigs
Mortality:	High in pigs 1 to 3 days old, decreasing incidence with age	High	Moderate	Moderate to high
Age pattern:	Affects pigs and sows	Affects pigs only	Affects mainly young pigs	Affects pigs of all ages but mainly weanlings
Course:	Acute	Acute but may become chronic	Acute to subacute	Peracute to chronic
Clinical signs:				
Diarrhea	Watery	Hemorrhagic	Mild to watery	Variable but primarily severe and mucohemorrhagic
Vomition	Yes, in pigs and sows	Occasional	No	No
Lesions:				
Jejunum	Marked villous atrophy, thin-walled, catarrhal enteritis, some hemorrhage and inflammation	Severe necrosis, hemorrhage, emphysema	Villous atrophy, absent to moderate, often segmental	Normal; usually empty
Colon	None, water contents	None; hemorrhagic contents	Distension with gas, watery contents	Normal to mucohemorrhagic enteritis
Mesentery	Congested	Lymph nodes congested	Edema	Edema
Diagnostic tests:	Fluorescent antibody; serum-neutralization isolation of TGE virus	Isolation of *C. perfringens;* toxin demonstration	Isolation and serotyping of *E.coli*	Isolation of numerous *Borrelia* sp. and *Vibrio coli* is suggestive

Lameness in Swine a Problem

R. D. Fritschen

District Extension Specialist (Animal Science)

Feet and leg problems of swine have become an enigma. Sore feet, lumpy legs, buck knees, post legs and abnormal walk are common problems among many modern pigs. Further, feet and leg problems are often increased as production moves toward confinement. In an attempt to solve field problems involving feet and leg abnormalties we have often attempted to incriminate nutrition, disease and, in some cases, genetics.

Northeast Station investigations have approached leg problems and, especially, feet problems, from a management-anatomy viewpoint. Research into foot abnormalities is scarce.

Part of the reason for the absence of research is the difficulty in physically handling the live pig to evaluate its feet. And there is no point in the slaughter process that allows for foot evaluation and study with necessary identification.

Pigs Lifted off Feet

Recently a device was designed and constructed at this Station that would lift the pig off its feet in a standing position. (Figure 1). The manner in which the pig is lifted prevents nearly all struggling and thrashing. This makes claw measurement and injury evaluation easier.

First Study

A study was begun in 1970 to determine if there is a relationship between leg abnormalities and injuries to the bottom of the feet. A subjective scoring system was developed to put a numerical value on the degree of abnormality to the front or rear legs as well as the front or rear feet.

Each pig was allowed to walk freely down an alley to be scored visually for leg abnormalities. This was followed by restraining the pig for scoring the feet. A summary of this study is shown in Table 1.

The rear feet have a higher injury value than the front feet (Figure 2). The same relationship exists between the rear and front legs. The relationship between sore feet and abnormal legs suggests that injuries on the bottom of the feet may predispose to leg problems. Obviously, there are structural differences between front and rear legs that could account for some of the difference in injury score. However, the association between "sore feet and bad legs" appears real. Data also suggest that the rear feet and legs play a different and dominant role in locomotion or movement.

Second Study

Since the one component of the pig's environment that he is least able to disassociate himself from is the material he must stand or walk on, research was directed at his feet—more specifically his claws.

Five-Category Scoring

Fifty pigs were used to study the effect of 25 and 100% slatted floor on front versus rear and inside versus outside claw injury. In addition, a comparison was made as to the differences in length and width of the rear inside and outside claws and the effect of 25 and 100% slatted floor on these measurements.

A plastic caliper graduated in 1/16 of an inch was used for claw measurements. The base for the claw's measurements was the interdigital cleft to the tip of the claw (length), and to the side of the claw (width). A five-category scoring system with corresponding values (normal = 1; cracks = 2; scuff = 3; laceration = 4; ulceration = 5) was used to determine the magnitude of injury. The single highest score (not additive) was used.

Table 2 shows the claw lengths

Table 1. Relationship between leg abnormalities and injuries to bottom of feet.[a,b]

	Front legs		Rear legs	Front feet		Rear feet
Abnormality-injury score	1.9		3.4	4.0		5.7
% difference		44			30	

[a] Additive scoring system. Larger values indicate greater abnormality.
[b] Based upon 120 pigs.

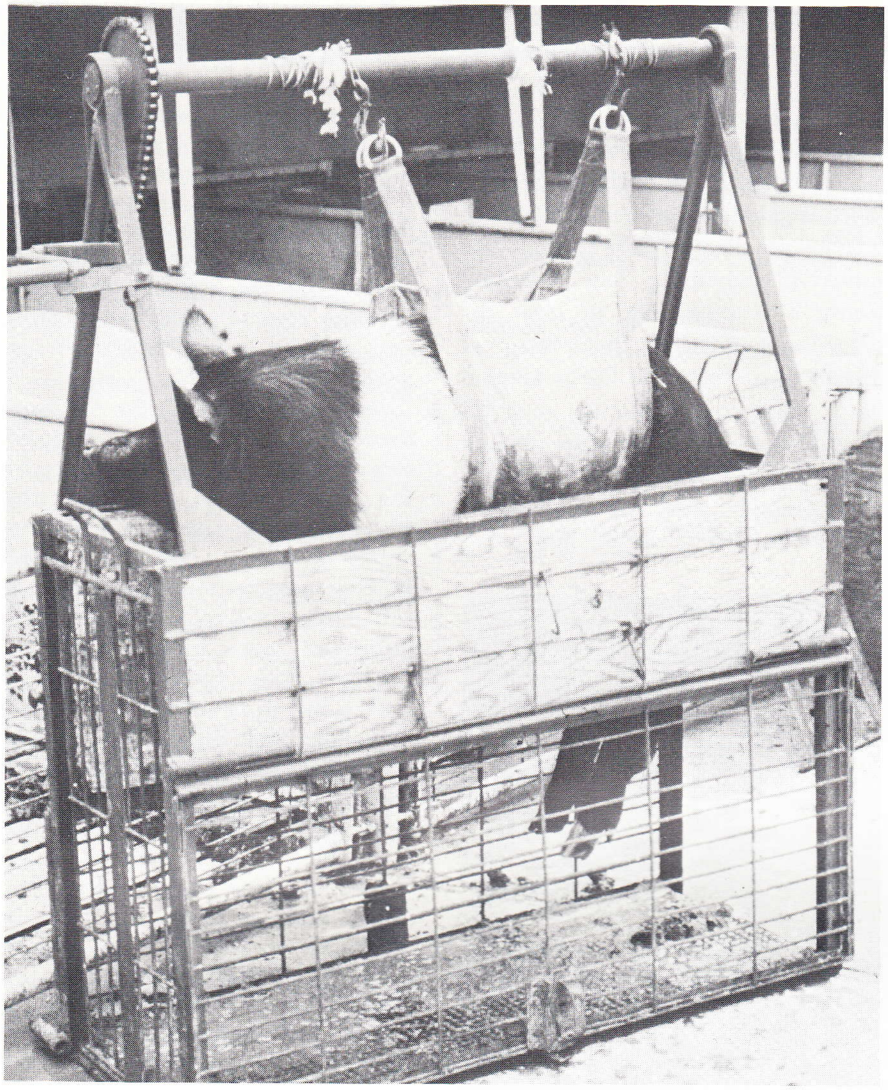

Figure 1. Lifting device used to raise pigs off their feet for claw measurement and scoring.

for inside and outside claws and for 25 and 100% slatted floor.

Data in Table 2 show that outside claws are considerably longer than inside claws. Further, it appears that pigs reared on 100% slatted floor have a shorter claw than pigs reared on 25% slatted floor. Apparently some solid floor area prevents the claws from unnecessary wear. Then too, enough organic material may have formed on the 75% solid (25% slats) floor to protect pigs' feet from the abrasive characteristic of concrete.

Table 3 summarizes the average claw widths for inside and outside on 25 and 100% slatted floor.

This study shows outside claws significantly wider than inside claws. There was no significant effect of percent slats on claw width. Thus, while the greater area reduced claw length, it had no effect on width. The realization that the outside claw is longer and wider than the inside claw helps to understand some of the pig's problems.

For example, if a pig's outside claw is much larger than its inside claw, the pig will tend to turn its leg and foot out to a commensurate degree. Few people have considered claw condition as a factor in swine lameness. A high percentage of lameness in finishing swine may, in fact, be due to claw injury or damage either directly or indirectly.

Eight Claws Scored

The problem of foot injuries begins to come into focus as we become aware that anatomically rear outside claws in this study have an area of 1.98 square inches (length x width) compared to 1.49 square inches for inside claws. This makes inside claws nearly .50 square inches smaller than outside, or a difference of 24.4%.

Next question: "What effect does this disproportionate claw dimension and the amount of slatted floor have upon the incidence of claw injury?"

To evaluate the injury aspect the same five-category scoring system was employed. All eight claws were scored and data analyzed as total outside and inside injury. Results are in Table 4.

Data in Table 4 indicate that the outside (larger) claw does sustain a greater degree of injury than the inside (smaller) claw (3.71 vs 3.10). This was true for pigs reared on either 100 or 25% slatted floor. The difference between inside and outside score was significantly greater for the pigs on 100% slatted floor.

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Table 2. Average outside and inside claw lengths on 25 and 100% slatted floors.

% Slats	100	25	Av
Outside claw (inches)	1.71	1.82	1.77[a]
Inside claw, (inches)	1.42	1.53	1.48
Av	1.57	1.68[b]	

[a] Outside claws significantly longer than inside claws ($P < .001$) .
[b] Claws on 25% slatted floor significantly longer ($P < .005$) than on 100% slatted floor.

Table 3. Average outside and inside claw widths on 25 and 100% slatted floor.

% Slats	100	25	Av
Outside claw, (inches)	1.13	1.10	1.12[a]
Inside claw, (inches)	1.03	.99	1.01
Av	1.08	1.04	

[a] Outside claws significantly wider than inside claws ($P < .01$).

Lameness in Swine

(continued from page 29)

Summary

The statistics from this investigation show that outside claws, on the feet measured, are somewhat larger than inside claws. The data also suggest that this difference occurs at a high level of repeatability. Some suggest that the degree of difference in claw size between pigs is inherited. Because of the high level of repeatability it would seem difficult, if not impossible, to select away from this trait with any accuracy except where extreme differences are observed.

The reason the outside claw has a higher degree of injury is almost certainly because it is larger than the inside claw. Since the outside claw has more net area in contact with the walking surface there is an unequal amount of body weight carried on the outside claw as opposed to the inside claw. Further, there is a difference in claw dimension and injury between pigs reared on 100 and 25% slatted floor. And this difference suggests that the overall condition of feet from pigs reared on 25% slatted floor is more desirable than those reared on 100% slatted floor.

Figure 2. Rear feet of market pig. Note the shorter inside and longer outside claw and the difference in injury between the two claws.

Table 4. Relationship between outside vs inside injury score and % slats.

% Slats	100	25	Av
Outside claws	3.87	3.54	3.71[a]
Inside claws	3.00	3.20	3.10
Difference	.87[b]	.34	
Av	3.44	3.37	

[a] Injury score significantly greater on outside claw ($P < .001$).
[b] Interaction between claw x slat significant ($P < .025$).

Nebraska Livestock

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The Nebraska Department of Environmental Control (DEC) is the state agency responsible for developing programs for the prevention, control and abatement of new or existing pollution of air, water and land.

In late June, 1972, the Environmental Control Council adopted new rules and regulations pertaining to livestock waste control, which changed the program from voluntary to a regulatory type. DEC is now required to make on-site inspections of livestock operations to determine the need for livestock waste control facilities.

If a livestock operator feels he may have a pollution problem or potential, it is his responsibility to contact DEC, requesting an inspection. This applies to all livestock operations.

The deadline date for the effective control of livestock wastes in Nebraska is Dec. 31, 1974, with earlier compliance where necessary. Deadlines have been established for not only livestock waste but all other types of waste as well.

The Environmental Protection Act and Water Quality Standards make no distinction as to the persons involved, type of waste or source. Their concern is with the effect on Nebraska's environment.

DEC has supplied County Extension and SCS offices with information cards, "Inspection Request for Feedlot Waste Controls." These can be completed by those requesting inspections and mailed to DEC. If an operator cannot obtain one of these information cards, he may simply call or write DEC requesting an inspection.

Requirements for Control

Livestock waste control facilities will be required whenever the runoff from a feedlot creates a nuisance or other objectionable conditions, or violates Nebraska Water Quality Standards. Minor runoff of

wastes onto adjoining property will be allowed, if the operator has obtained the permission of the owner of such property. In no event will runoff be allowed in violation of Nebraska Water Quality Standards.

When controls are required, a compliance schedule for preparation of plans and completion of construction will be sent to the operator. These plans can be designed by the SCS, Consulting Engineers or other persons, so long as they are designed to meet requirements set forth in Section 4 of the current "Nebraska Rules and Regulations Pertaining to Livestock Waste Control."

Information regarding livestock waste control facilities must be submitted to DEC for approval on the application form, "Data Sheet for Livestock Waste Control Facilities," furnished by DEC. These forms can be obtained from County Extension and SCS offices.

Table 1. Guidelines on Livestock Waste Control Facilities

Livestock Operation Inspected by DEC[a]

(Livestock operators who are not inspected or notified by DEC and feel that they may have a pollution problem or potention should request a visit by DEC)

If Waste Control Not Required

1. DEC advises no controls needed. DEC also advises SCS and ASCS.
2. DEC issues permit to operator, if requested.

If Waste Controls Required

1. DEC notifies operaor that waste controls are needed. DEC also advises SCS and ASCS.
2. Operator files request with ASCS if REAP cost-sharing funds are desired.
3. Operator has waste system designed by SCS, registered engineer or others.
4. Operator not having SCS design system but desiring REAP funds must contact SCS for approval.
5. Milk producers (both Grade A and Manufacturing) must notify the Bureau of Dairies and Food, Dept. of Agriculture, Box 4695, Lincoln 68509 when waste plans have been completed. Bureau will then send representatives to review plans.
6. Operator sends plans to DEC.
7. DEC approves adequate plans and returns to operator.
8. Operator arranges for layout in accordance with plans and engages contractor or builds with own equipment.
9. Operator has SCS or registered engineer certify that construction follows original plans and specifications. For REAP support SCS approval is mandatory.
10. Operator sends this certification to DEC.
11. DEC sends operator permit.
12. Operator operates and manages waste control facilities in accordance with recommended practices.

[a] Department of Environmental Control

Permits Required

The operator of any proposed or existing livestock operation, which requires or will require livestock waste control facilities, must obtain a permit from DEC. At the time DEC approves plans and specifications for livestock waste control facilities, it will send the operator a letter of formal approval and a Certification Form to be completed, affirming that construction has been completed according to approved plans and specifications.

At this time, DEC will issue a permit for operation of the facilities. This permit will afford the operator protection under Rule 8 of the "Nebraska Rules and Regulations Pertaining to Livestock Waste Control." Rule 8 states: "When a livestock operation is conducted in accordance with these rules and regulations and the best practicable technology is applied to alleviate offensive odors and other objectionable conditions, it shall be deemed prima facie evidence that a nuisance does not exist."

Any operator whose livestock operation does not require waste control facilities may also, upon certification by the director, apply for and receive a permit qualifying him for the protection afforded by Rule 8.

Failure to construct waste control facilities where required, and failure to obtain a permit, will be grounds for administrative enforcement procedures and possible criminal penalties.

A livestock waste control facility will not be approved for any existing or proposed facility which is operated in violation of any zoning regulations of any local governmental body. It is the responsibility of the operator to determine whether any such zoning regulations exist. In the event an existing feedlot with approved waste control facilities wishes to expand approved operations, information regarding livestock waste control for the expansion must be submitted to DEC for approval.

Financial Assistance

REAP (Rural environmental Assistance Program) cost-sharing funds for construction of livestock waste control facilities have been available through ASCS under the following conditions:

1. DEC makes an on-site inspection and determines that controls are required.
2. Operator files request with ASCS for REAP cost-sharing funds.
3. Plans and specifications for control meet SCS approval.
4. Plans and specifications receive DEC approval.
5. Completion of construction of controls according to approved plans and specifications.

Controls and Capacity

Waste control facilities for open swine lots must provide capacity to control the runoff which can be expected from a 10-year, 24-hour storm. This is the amount of rainfall which can be expected during a 24-hour period once in 10 years.

For confinement units, the liquid manure storage facilities must have a capacity to store all waste material produced over a 120-day period. These facilities usually include a slatted floor which allows solid and liquid manure to drop into a holding pit beneath the floor. If space is not provided in the building, additional manure storage with a combined capacity of 120 days will be needed.

In new buildings, sufficient storage can be provided in the building manure pit or additional outside space made available, depending on local conditions.

For existing buildings, the 120-day storage requirement may create a need for additional storage outside of the building.

Waste Management

(continued from page 31)

Odors are likely to be a problem unless a lagoon is built with capacity to provide for aerobic (oxygen present throughout) conditions. Nebraska does not now have air regulations pertaining to livestock waste odors; however, the producer should concern himself with management steps that can be taken to keep odors under control.

The wise selection of a site for a new swine production system can help reduce the need for waste control facilities if the animals are not housed or confined in buildings. In addition to the area required for buildings, additional land will be needed for disposal of manure—the amount of space will depend on the type of waste system used.

Management

Livestock waste systems must be managed to insure proper functioning.

1. Debris basins must be cleaned at least once or twice a year to maintain the designed capacity.

2. Holding ponds must be emptied within the designed disposal time to ready the system for the next runoff.

3. Confinement units with 120-day storage may require more frequent emptying.

4. Care must be taken in site selection for disposal of wastes in order to prevent water pollution.

5. Systems may require maintenance if soil erosion of banks or over-topping has occurred.

Neglect to manage these systems will definitely cause failure or problems.

Table 1 summarizes the steps to be taken in complying with present rules and regulations:

Summary

The Nebraska Department of Environmental Control has received excellent cooperation from the livestock industry and all agencies involved in the program. With this cooperation, we feel that the goals of livestock waste control will be accomplished.