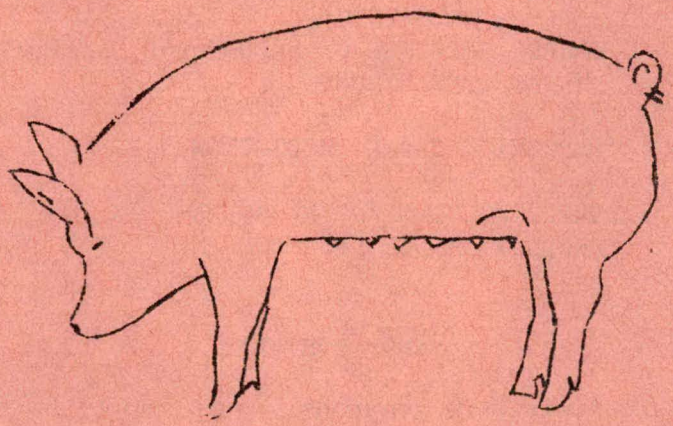
1963

Seventh Annual Swine Field Day 1963 Complete Report

Animal Husbandry Department
South Dakota State University

SEVENTH ANNUAL SWINE DAY REPORTS



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Acknowledgments

Certain ration ingredients were generously supplied by Merck and Company, Rahway, New Jersey; American Cyanamid Company, Princeton, New Jersey; Eli Lilly and Company, Greenfield, Indiana; and Dawe's Laboratories, Inc., Chicago, Illinois.

The excellent management and care of the animals was supervised by Carl Ost, Superintendent, and associates Chris Diepholz, Cordell Costar, and Arden Ahnberg.

South Dakota State College
Animal Science Department Brookings, South Dakota
Agricultural Experiment Station
A.S. Mimeo Series 63-22

MORE TESTING IS NEEDED!

R. W. Seerley

The purebred swine business, like farming or any other business, must be progressive, sensitive to change, and always looking for new and better ways to grow and prosper. The ideas presented in this article are not especially new, in fact, good swine producers have already put most of these ideas into practice. However, some breeders still use production programs and salesmanship of ten years ago and now have a second rate program. The decision must be made--shall the program remain second rate or can some newer information, particularly that regarding accepted testing programs be put into use.

On the farm testing is being promoted by breed associations, and it seems to be accepted by most purebred breeders, yet there are far too few animals available for sale with complete records behind them. The commercial man, especially tomorrow's commercial producer, who will have a larger volume, is actively seeking herd sires from herds where he can evaluate all animals on their complete records. This is evident from the number of articles appearing lately on the subject and by the interest in boar testing stations.

This last summer, breeders of one breed displayed at their type conference some of the best individuals in the history of the breed. It was easy to come home from that meeting with a sense of progress about the swine industry. However, as I reflect back on the conference and in visiting back at the pens with breeders, they, in general, could not provide all the information desirable to make possible the best selection of a great herd sire. Buyers had to deal with what they saw, while for the other important traits he could only hope for the average of the breed. When average values are assigned, only an average price can be expected. This can hurt everyone. If the animal is superior, the breeder does not receive full value, but if the pig is inferior, the commercial man pays too much--and more important--his program has been hurt. The commercial man wants to deal through knowledge. When forced to gamble on the unknown, he must be conservative.

A quick glance at results from any boar testing station will clearly show there are quite noticeable differences within a breed in the performance of boars and in cut-out data from related pigs. Some good and some bad results, as shown by tests, indicate there is a lot of variation among the animals which are being promoted for sale. The variation, in part, is due to inadequate information to make sound decisions when selecting replacement stock. Consequently, there is variation in the herd, and some inferior performing pigs are inadvertently retained for breeding.

Is the average purebred breeder (not the top-notch breeder) selecting his herd sires and replacement gilts primarily on conformation, breed characteristics, soundness of feet and legs, mammary development, carcass results and secondarily on growth rate, freedom from disease and feed efficiency? In contrast, is the commercial producer selecting primarily on freedom of disease, growth rate, litter size, mothering ability, milking ability, sound underlines, and secondarily on conformation and meatiness? The commercial man wants more information on feed

efficiency and he is starting to buy where there are good records on feed efficiency. Obviously the two concepts of purebred breeder and commercial producer do not completely agree--then who is right? Clearly, both concepts are a little off base as all of these important selection traits need to be integrated into purebred and commercial programs. We must be about our business of eliminating the poor performing, inferior meat-quality hogs, and propagating the faster-growing pigs with excellent performance and carcass records. This can be accomplished more rapidly by testing at home and in stations--not by just a few breeders, but by everyone.

Litter Testing

There are advantages for testing most of the hogs on the farm. Two principle advantages are: (1) to provide more information for yourself about replacement gilts, and (2) more information for prospective buyers of both boars and gilts. Litters and individual pigs can be compared on growth rate, backfat probe and carcass cut-out. Litters can be compared on feed efficiency. The heritability of these traits is high enough to permit good progress if careful selection is practiced.

A good practice is to enroll the litter in the breed production registry (PR). After they qualify for PR, weigh the pigs at weaning, then start keeping records on feed given to the litter. Alternatives to using weaning weight would be to use an assigned birth weight (3 lb.), actual birth weight, or 21, 35 or 56 day weights as the beginning weights for the test period. The end of the test period may be at a given age or average weight. Weight at 154 days of age is commonly used and an average weight of 200 pounds is also commonly used. Weighing at approximately 200 pounds and probing then may save some labor. A typical litter record sheet and example is presented in figure 1. Select for carcass test at least two pigs from each litter with good records to qualify the litter for certification (CL). Then probe the other pigs, or at least those kept for replacement, or to be offered for sale. After the pigs have completed test, they can be removed and placed with replacement stock or placed in a "sale" pen. At the time of sale you have the figures available that will satisfy any commercial producer or purebred breeder.

Participation in the Superior Meat Sire (SMS) program is also suggested. Litters can be designated for this purpose.

Maybe the reaction to litter testing is that it requires too much labor and then there is the question about witnesses to these data. My reply to the first is that the price received for the good record pigs will far more than pay for the cost of the labor. Some people will not agree with me, but I do not believe this particular type of testing requires, nor can it be expected to have, a witness for every weight and measurement. Breeders want customers coming back year after year to buy breeding stock and the best approach to this goal is through honesty and integrity. Business men have learned that satisfying the customer pays good dividends. Misrepresentation of a product is soon discovered and most people quickly learn to avoid unscrupulous salesmen. So approach this type of testing with accurate records and give it a good chance to help your program and the swine industry.

Litter Performance Record Sheet

Litter No. 20 Gilts 4 Boars 5 Date of Birth Feb 1, 1963

Sire Super King Dam Mrs. King 1st 2nd (3rd) Litter

Remarks: Mr. and Mrs King have a goud litter.

Weaning Date March 15 End Test Date June 15

Pig No. & Sex	No. nipples Left	Right	Beginning test wt., lb. Date March 15	End test wt., lb. Date June 15	Av. daily gain, lb.	Probe 200 lb. adj.	Remarks
1 S	6	7	40	195	1.68	1.36	Sell
2 S	6	6	45	205	1.74	1.23	Replacement
3 S	6	6	35	180	1.58	1.41	Sell
4 S	7	5	30	183	1.66	1.19	Sell Commercial
5 B	6	6	50	230	1.96	1.12	Sell
6 Br	6	5	40	210	1.85	1.40	LE - 30.5 LE: 5.6 HL: 48%
7 B	6	7	45	210	1.79	1.08	Sell
8 B	6	6	42	195	1.66	1.11	Sell
9 Br	6	6	37	200	1.77	1.30	LE: 30.8 LE: 4.89 HL: 40%
10							
11							
12							
13							
14							
15							

Total wt. 364 1808 Gain on test 1444

Av. 40.4 200.9 Av. probe 1.24 in.

$$\text{Av. daily gain} = \frac{\text{Total litter gain on exp.}}{\text{Total pig days on test}} = \frac{1444}{828} = 1.74$$

$$\text{Feed efficiency} = \frac{\text{Total feed on exp.}}{\text{Total litter gain on exp.}} = \frac{4350}{1444} = 3.01$$

Figure 1. Example of a litter record sheet.

Feed records

Creep Consumption 56 lb.

Feed Provided During Test Period

Date	Lb.
3-15 Start	588
4-2	830
4-14	715
4-25	829
5-4	940
5-11	550

Total 4452

End Weighback 102

Feed Consumed 4350

South Dakota State College
Animal Science Department Brookings, South Dakota
Agricultural Experiment Station

A.S. Mimeo Series 63-23

PORK CARCASS COMPOSITION AS INFLUENCED BY SLAUGHTER WEIGHT

Harold J. Tuma and Robert C. Fletcher

The common goal for those engaged in producing and processing pork should be the efficient production of a product which ultimately is highly desirable to the consumer. This means that any retail pork item must be lean, attractive to the eye and yet be very tasty.

This study, concerned with changes in body composition, is a portion of a larger project concerned with more efficient production and utilization of pork.

Seventy-nine barrows and gilts were slaughtered at one of four weights (150, 180, 210 or 240 lb.) in the college meat laboratory. Both sides of each carcass were separated into trimmed wholesale cuts, then each of these further processed into an edible portion, fat trim and bone.

Summary

1. As live weight increased (Table 1):
   a) dressing percent increased
   b) percent edible portion decreased only very slightly
   c) percent fat increased
   d) percent bone decreased
   e) the indicators of quality did not change appreciably

2. The gilts were longer, trimmer and meatier than the barrows.

3. Computing the percentage of the various body components on a carcass basis may give a completely different effect than when they are computed on a live weight basis (Table 1).

Table 1. Title Components of the Hog As Influenced By Live Weight

Wt.	Dressing percent	Percent head, viscera and pluck	Percent leaf fat	Percent four lean cuts of carcass weight	Percent four lean cuts of live weight	Percent ham of carcass weight	Percent ham of live weight	Percent edible portion of carcass weight	Percent fat of carcass weight	Percent bone of carcass weight
150	71.81	17.88	2.84	54.95	39.13	20.19	14.14	57.85	27.61	10.88
180	72.82	17.19	3.30	53.20	38.72	19.42	14.14	59.57	27.59	10.31
210	75.26	15.54	4.49	51.81	39.25	18.08	13.71	57.23	31.23	10.05
240	75.71	15.96	4.30	51.74	38.61	18.41	13.74	56.55	31.97	9.16

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A.S. Mimeo Series 63-24

CALCIUM AND PHOSPHORUS FOR GROWING-FINISHING SPECIFIC-PATHOGEN-FREE PIGS

R. W. Seerley[1], J. W. McCarty[1] and A. E. Dittman[2]

Since the introduction of SPF pigs on farms, nutritionists have wondered if the nutrient requirements of the pigs are similar to non-SPF pigs. Theroetically if the animal does not have a physiological stress, such as disease, and a good environment is provided, he should gain faster and thereby need more daily nutrients. However, the healthy, fast gaining pig will normally eat more feed in order to meet his nutrient requirements. Consequently, the nutrient requirements in terms of amount of nutrient per pound of total feed should generally be the same for SPF and non-SPF pigs. The word generally is emphasized because a specific requirement of a microingredient(s) might be slightly different. Already a few swine producers of SPF pigs have questioned the calcium and phosphorus requirements. Their concern logically developed from observations of stiff legs and more feet and leg trouble with the SPF pigs than was observed in the herd before repopulating with SPF pigs. With these observations in mind, two field trials with various levels of calcium and phosphorus in the ration were initiated at the Eureka Experiment Station.

Experimental Procedure

Two hundred one crossbred specific-pathogen-free pigs have been used in two trials. The experiment treatments were:

Trial 1	Lots 1 and 3	Calcium (Ca) and phosphorus (P) at NRC recommended level (calculated)
	Lots 2 and 4	Ca and P each between 0.2 and 0.3% above NRC recommended level (calculated)
Trial 2	Lots 1 and 5	Ca and P below NRC recommended level
	Lots 2 and 6	Ca and P at NRC recommended level
	Lots 3 and 7	Ca and P each 0.3% above NRC recommended level
	Lots 4 and 8	Ca and P each 0.6% above NRC recommended level

Corn-soybean meal rations were used in both trials. At approximately 110 pounds body weight, the percent crude protein in the rations was decreased and the calcium and phosphorus were changed to comply with NRC's recommended levels. The rations are shown in Tables 1 and 2. Zinc was added to the ration as a part of the salt mixture and provided 40 parts per million of zinc. Feed and water were provided ad libitum. The pigs were confined in dirt lots for both trials. Trial 1 was conducted during the winter months of 1962-63 and trial 2 was conducted during the summer months of 1963.

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[1] Department of Animal Science.

[2] Superintendent of North Central Substation, Eureka, South Dakota.

Appreciation is expressed to personnel at the station for their cooperation and assistance on this project.

Table 1. Composition of Rations Used in Trial 1

	Ca and P at recommended level		High Ca and P	
	To 110 lb.	110 to 200 lb.	To 110 lb.	110 to 200 lb.
	lb.	lb.	lb.	lb.
Gr. yellow shelled corn	780.0	859.0	759.0	848.0
Soybean meal (44%)	144.0	70.0	155.0	71.0
Dehydrated alfalfa meal (17%)	50.0	50.0	50.0	50.0
Dicalcium phosphate	11.0	7.0	21.0	18.0
Limestone	6.0	6.0	6.0	5.0
T.M. salt	5.0	5.0	5.0	5.0
Vitamin-antibiotic premix[1]	4.50	3.75	4.50	3.75
	1000.5	999.75	1000.5	999.75
Calculated analysis				
Crude protein, %	15.13	12.50	15.15	12.53
Calcium, %	0.65	0.52	0.91	0.79
Phosphorus, %	0.51	0.40	0.69	0.61
Chemical analysis				
Crude protein, %	15.74	--	16.20	--
Calcium, %	.56	--	.89	--
Phosphorus, %	.50	--	.68	--

[1] Vitamins provided in the premix were: 1 mg. riboflavin, 2 mg. pantothenic acid, 4.5 mg. niacin, 5 mg. choline, 5 mcg. B_{12}, 300 I.U. vitamin A and 70 I.U. vitamin D per pound of ration. Two mg. of tylosin and 1.0 mg. of tylosin per pound of ration was provided in the grower and finisher rations, respectively.

Table 2. Composition of Rations Used in Trial 2

C and P Treatment	Below NRC		NRC		0.3% Above NRC		0.6% Above NRC	
	To 110 lb.	110 to 200 lb.	To 110 lb.	110 to 200 lb.	To 110 lb.	110 to 200 lb.	To 110 lb.	110 to 200 lb.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Gr. yellow shelled corn	787	881	779	872	761	856	744	839
Soybean meal (44%)	170	80	170	82	175	85	180	90
Dehydrated alfalfa meal (17%)	25	25	25	25	25	25	25	25
Dicalcium phosphate	0	0	10	7	27	23	43	40
Limestone	10	7	8	7	4	4	0	0
T.M. salt	5	5	5	5	5	5	5	5
Vitamin-antibiotic premix[1]	3	2	3	2	3	2	3	2
Calculated analysis								
Crude protein, %	15.19	11.96	15.15	11.97	15.18	11.96	15.23	12.00
Calcium, %	0.47	0.30	0.65	0.52	0.95	0.82	1.22	1.11
Phosphorus, %	0.32	0.28	0.50	0.41	0.80	0.70	1.09	1.00
Chemical Analysis								
Crude protein, %	15.35	11.98	15.49	11.61	14.97	12.27	17.15	11.50
Calcium, %	0.55	0.44	0.66	0.68	0.81	0.76	1.11	1.03
Phosphorus, %	0.36	0.34	0.55	0.43	0.79	0.65	1.17	1.02

[1] Vitamins provided in the premix were 1 mg. riboflavin, 2 mg. pantothenic acid, 4.5 mg. niacin, 5 mg. choline, 5 mcg. B_{12}, 1000 I.U. vitamin A and 200 I.U. vitamin D per pound of ration. One mg. of chlortetracycline and 0.5 mg. of chlortetracycline were provided in the grower and finisher rations, respectively.

Results

The results of these trials indicate the levels of calcium (Ca) and phosphorus (P) as recommended by the National Research Council are adequate for normal daily gains and feed conversion. All pigs on the experiment appeared normal and healthy. In trial 2, pigs fed less than the established Ca and P requirements did not have any apparent deficiency symptoms, while the pigs fed high calcium levels did not have any evidence of parakeratosis.

In trial 1, average daily gains of the control pigs and pigs fed more Ca and P were essentially the same for both groups. Feed consumption by the two treatment groups did not follow a consistent pattern between the two replications, but all values for both treatments indicated good feed consumption. Pigs fed more Ca and P required approximately 0.28 pound (7.6%) more feed per pound of gain than the control pigs.

In trial 2, pigs fed the recommended levels of Ca and P had the best performance. These pigs gained 6.6%, 2.3% and 3.5% faster than pigs fed less than or approximately 0.3% or 0.6% more Ca and P than recommended, respectively. On the basis of daily gains, the low levels of Ca and P probably were not adequate for optimum gains, however, a more detailed study would be necessary for complete clarification.

Feed consumption was good for all groups. Pigs given the higher Ca and P rations actually ate more feed per day than pigs fed the lower Ca and P rations. The reason for this is not known. Perhaps the energy in the rations was lowered sufficiently by the substitution of corn so that the pigs ate more in order to meet their energy requirement. Another possibility is the palatability of the rations was improved, but the former possibility seems more logical than the latter.

Feed required per pound of gain was adversely affected by inadequate or excessive quantities of Ca and P in the rations. Both trials suggested high Ca and P levels in the ration will cause poorer feed utilization by the growing-finishing pig.

Summary

1. The results of two field trials indicate the current recommended levels of calcium and phosphorus are adequate for growing-finishing specific-pathogen-free pigs.

2. Pigs fed high levels of Ca did not have parakeratosis.

3. Feed efficiency was adversely affected by either inadequate or excessive Ca and P in the ration.

Table 3. Results of Trial 1

	Calcium and Phosphorus at Recommended Level	High Levels of Calcium and Phosphorus
Total no. pigs (both reps)	22	23
Av. days on experiment		
Rep 1	77.8	76.7
Rep 2	81.0	76.5
Av. final wt., lb.		
Rep 1	214.4	211.1
Rep 2	211.6	206.0
Av. daily gain, lb.		
Rep 1	1.83	1.81
Rep 2	1.74	1.76
Av.	1.78	1.79
Av. daily feed, lb.		
Rep 1	7.13	6.62
Rep 2	6.14	6.85
Av.	6.62	6.73
Av. feed/lb. gain, lb.		
Rep 1	3.95	4.01
Rep 2	3.42	3.91
Av.	3.68	3.96

The range in average initial weights for all lots was 70.7 to 72.9 lb.

Table 4. Results of Trial 2

Calcium and Phosphorus Levels	Below NRC	Recommended NRC	Approx. 0.3% Above NRC	Approx. 0.6% Above NRC
Total no. pigs[1]	40	40	37	39
Av. initial wt., lb.				
Group 1	70.5	70.7	70.7	70.6
Group 2	43.0	42.5	42.7	42.7
Av. final wt., lb.				
Group 1	220	225	219	222
Group 2	210	214	218	208
Av. daily gain, lb.				
Group 1	1.74	1.83	1.75	1.81
Group 2	1.63	1.76	1.74	1.68
Av.	1.67	1.78	1.74	1.72
Av. daily feed, lb.				
Group 1	6.84	6.71	7.07	7.15
Group 2	5.82	5.80	6.06	6.12
Av.	6.28	6.22	6.53	6.58
Av. feed/lb. gain, lb.				
Group 1	3.95	3.67	4.05	3.96
Group 2	3.59	3.33	3.51	3.69
Av.	3.76	3.49	3.76	3.81

[1] Twenty pigs per pen were initially started in each group. Four pigs were removed from the experiment for reasons unrelated to the treatments.

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A.S. Mimeo Series 63-25

PERFORMANCE IN AN EXPERIMENTAL SPF HERD

J. W. McCarty[1] and Albert Dittman[2]

Disease free or SPF swine production has received increasing attention in recent years as an attempt to improve the environment under which pigs are produced. SPF procedures were developed to combat specifically atrophic rhinitis (AR) and virus pig pneumonia (VPP) which have been very costly to swine producers over the last several years. These diseases are transmitted principally by pig-to-pig contact once a herd is infected, or a clean herd is infected by introducing infected animals such as replacements for the breeding herd. A producer can unknowingly infect his herd by introducing apparently healthy, but actually carrier animals. Certified SPF herds, which must be maintained free of AR and VPP as determined by inspection at slaughter, are a source of "clean" breeding animals for these two diseases.

Since 1953, the North Central Substation herd at Eureka has been maintained as a breed-line rotation cross in which crossbred gilts produced each season were mated to boars of the Hampshire, Duroc and Yorkshire breeds in their turn in the rotation. Boars were from inbred lines produced at the Brookings Station.

In 1961, using crossbred animals then available, the Eureka Station was repopulated with SPF pigs. Therefore, the same systematic rotation cross has been continued, 1963 pigs being the 16th generation of the cross. SPF Hampshire boars purchased from two South Dakota purebred herds sired the 1963 pig crop.

In order to clean up facilities at the Eureka Station prior to repopulation with SPF pigs, all hogs were removed for a period of approximately six months. During this time equipment and facilities were thoroughly cleaned.

At Eureka farrowing facilities include farrowing stalls which were built into an existing building. Supplemental heat during farrowing is supplied by heat lamps. Pigs are raised to market weight on native grass-alflafa pasture which is set up for use on a three year rotation. Management and rations follow current recommendations for sound swine production. No special management or rations are provided, nor have they been found necessary, except that there is strict control to maintain isolation of the pigs. Replacement breeding animals must come from Certified SPF herds.

Herd Performance

Primary objective of the Eureka herd has been to demonstrate the usefulness of a systematic breed-rotation-cross for commercial swine production. Management, feeding and the collecting of production records are according to current Experiment Station recommendations. The program was initiated in 1947. Records indicate a good level of performance is being maintained by this mating system.

Litter Performance. Data are available for only two seasons since repopulation of the herd with SPF pigs, so that valid comparisons with the herd previous to that time cannot yet be made. However, performance of the pigs has generally been very

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satisfactory. Table 1 shows the litter performance summary for the first two years since SPF repopulation. 1962 spring and fall litters were produced by repeat matings of the same Yorkshire boar and breed-cross sows.

Growth rate to 56 and 140 days was less for 1963 than for 1962 spring pigs. This difference is partly seasonal and partly due to the fact that 1963 litters were produced by 19 of the 20 crossbred gilts raised in 1962. Therefore, dams of 1963 litters were almost an unselected group of the available gilts raised in 1962. No more selection than this was intentional, so that re-establishment of a 16-20 sow herd could be done as rapidly as possible.

Table 1. Litter Performance Summary
Eureka Station SPF Herd 1962, 1963

	1st Generation SPF 1962		2d Generation SPF 1963 Spring		
	Spring	Fall	Sire 1	Sire 2	Herd
Number litters	5	5	9	10	19
Average number pigs					
Farrowed	11.6	12.8	10.7	12.5	11.6
56 days	8.8	11.4	9.1	9.5	9.3
140 days	8.6	11.4	8.9	9.3	9.1
Average pig weight					
Farrowed	2.8	3.0	3.0	2.8	2.9
56 days	50	55	44	43	44
140 days	203	197	192	179	185
Average litter weight					
Farrowed	32	38	32	35	34
56 days	437	625	414	409	411
140 days	1745	2245	1711	1667	1687

Carcass Information. Carcass data are collected on a number of barrows in each pig crop in order to have as complete performance information as possible on the herd. A summary for these data is found in table 2.

Carcasses from first generation SPF pigs in 1962 carried much more backfat than is desirable for butcher hogs today. However, fatness in the carcass has been a characteristic of this particular cross and is not the result of the SPF management. The seasonal difference in loin eye area is interesting, especially since spring and fall pigs were produced by the same matings. No reason is apparent for this difference. In neither season were loin eyes as large as is desired by today's market.

Through 1962 sires of the crossbred pigs were from inbred lines. These lines were all closed prior to the time that there has been the current emphasis on carcass characteristics. Therefore, in choosing sires to use in the cross, there was not sufficient variability within the lines to provide desirable opportunities for selecting for carcass meatiness characteristics. Sires of 1963 pigs were from unrelated outbred herds. In their selection, emphasis was placed on apparent

Table 2. Carcass Data Summary
Eureka Station SPF Herd 1962, 1963

	1962		1963		
	Spring	Fall	Sire 1	Sire 2	Herd
Number carcasses	20	19	29	37	66
Average					
Market age, days	144	144	151	153	152
Market weight, lbs.	215	218	228	219	223
Cold carcass wt., lbs.	158	158	161	154	157
Carcass length, in.	29.7	29.8	29.6	28.9	29.2
Carcass backfat, in.	1.90	1.76	1.71	1.58	1.64
Loin eye area, sq. in.	3.10	3.83	3.91	3.94	3.93
Percent ham, loin	--	--	35.2	35.9	35.6
Percent lean cuts	--	--	52.3	53.3	52.8

Carcass data collected through the courtesy and cooperation of Armour and Company, Huron, South Dakota

meatiness. Data for 1963 indicate some change, not large, for both backfat and loin eye area. Carcasses averaged somewhat shorter in 1963 than in 1962.

Sire-Progeny Performance Differences. Because previous work has shown that sire differences can be of importance when analyzing herd differences, two sires were used for the 1963 pig crop. In the summary, of special interest is the difference between sire groups for 140 day weight. Pigs by sire 1 averaged 13 pounds or 6.7% heavier at the same age as compared to those pigs by sire 2. Pigs from sire 1 reached a minimum market weight of 200 pounds 10 days sooner than pigs by sire 2. Carcass data tends to favor pigs by sire 2 although the differences are small. These data are useful when making decisions about replacement animals saved for the breeding herd.

Comment. Repopulating the Eureka herd with SPF pigs and thereby removing some of the disease stress has resulted in a marked improvement in growth rate of pigs raised in the herd. This change has not necessitated changes in management except for maintaining strict herd isolation and using only known "clean" sires for breeding herd replacement.

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A.S. Mimeo Series 63-26

PROPER LOCATION OF FEEDER AND WATERER--OUTSIDE VERSUS INSIDE COMPARISONS

R. W. Seerley

In order to properly evaluate the best location of feeders and waterers in growing-finishing lots, the experiment should be conducted for several seasons and years. This experiment was initiated in 1961 and the results of a winter and summer trial were reported last year (A.S. Mimeo Series 63-3). The two trials reported herein are the third and fourth trials of the experiment. The results of these trials should be considered as a progress report. No conclusions will be made until more results from several seasons are available.

Experimental Procedure

A 52 x 14 foot uninsulated house with 4 pens and 4 adjoining 20 x 13 foot outside concrete pens was used for this experiment. The experimental design for the winter trial was:

	Location of Feeder	Location of Waterer
Lot 1	Outside	Outside
Lot 2	Outside	Inside
Lot 3	Inside	Inside (pigs could go outside)
Lot 4	Inside	Inside (pigs confined inside)

On October 31, 1962 40 pigs (10 pigs per pen) were allotted in the 4 pens for the winter trial. Automatic waterers were used for the inside waterers. A tank type waterer was placed outside in lot 1. The temperature of the water was thermostatically controlled during the winter study. Smidley feeders were used for all lots. The same rations were provided for all pigs. A grower ration was fed to an average body weight of 110 pounds, then a finisher ration was fed to the end of the trial.

The experimental design was changed slightly for the summer trial, which started on May 7, 1963. In this trial all pigs could go outside. The lot treatments were:

	Location of Feeder	Location of Waterer
Lot 1	Outside	Outside
Lot 2	Outside	Inside
Lot 3	Inside	Outside
Lot 4	Inside	Inside

Results and Discussion

This is a progress report. A complete summary will be published after more trials are completed.

The average monthly temperatures (high and low) and the extreme temperatures during each month are shown in table 1. Results of the winter trial are presented in table 2 and table 3 shows the summer trial results.

Winter Trial. The performance of pigs on all treatments was approximately equal. There were no apparent differences due to feeder and waterer location in this trial. The winter was relatively mild, except for approximately three weeks in January. During most of the trial the pigs appeared comfortable, and they were not reluctant to go out to drink and eat.

Summer Trial. Pigs fed and watered inside gained slightly faster than pigs in the other lots. These pigs ate more feed, which probably accounted for the faster daily gains. It was observed that the pigs consistently stayed inside the house during the mid-day hours. More data will be necessary in order to evaluate feeder and waterer location in relationship to the habits of the pigs. The results from the previous summer indicated an outside feeder and waterer might have some advantage. Since the two summer trials did not agree, perhaps the location of the feeder and waterer under the conditions of this experiment had little influence on the performance of the pigs.

Table 1. Average Monthly Temperatures and Extreme Temperatures, F°

	Monthly Average			Extremes	
	High	Low	Av.	High	Low
November, 1962	48.2	26.3	37.3	71	12
December, 1962	32.9	10.0	21.5	61	-18
January, 1963	16.0	- 6.7	4.7	55	-35
February, 1963	30.0	4.4	17.2	56	-16
May, 1963	68.6	44.4	56.5	87	21
June, 1963	81.9	57.4	69.7	97	43
July, 1963	82.6	59.2	70.9	94	48
August, 1963	81.1	56.5	68.8	91	43

Table 2. Inside Versus Outside Location of Feeder and Waterer--Winter Study[1]

Location of feeder Location of waterer Area for pigs	Outside Outside In and Out	Outside Inside In and Out	Inside Inside In and Out	Inside Inside In Only
No. pigs/lot	10	10	9[2]	10
Av. initial weight, lb.	41.3	41.5	42.0	41.6
Av. final weight, lb.	203.8	209.3	199.2	198.5
Days on experiment	104	104	104	104
Av. daily gain, lb.	1.56	1.61	1.55	1.55
Av. daily feed, lb.	5.30	5.39	5.13	5.21
Av. feed/lb. gain, lb.	3.39	3.34	3.32	3.36

[1] Trial started on October 31, 1962 and ended February 12, 1963.
[2] One pig was removed early in the trial for reasons unrelated to the experimental treatment.

Table 3. Inside Versus Outside Location of Feeder and Waterer--Summer Study[1]

Location of feeder Location of waterer	Outside Outside	Outside Inside	Inside Outside	Inside Inside
No. pigs/lot	10	10	10	10
Av. initial weight, lb.	49.7	49.9	49.7	49.7
Av. final weight, lb.	204.4	201.6	202.1	203.5
Days on experiment	98	104	97	91
Av. daily gain, lb.	1.58	1.46	1.57	1.69
Av. daily feed, lb.	5.16	4.89	5.06	5.63
Av. feed/lb. gain, lb.	3.27	3.35	3.22	3.33

[1] Trial started on May 7, 1963 and ended August 19, 1963.

Improving Swine Production

Swine Evaluation Stations have been erected in most of the leading swine producing states of the nation, and like the one in South Dakota, the stations help point the way to improved swine production.

Through the efforts of the South Dakota Swine Improvement Association working in cooperation with Animal Science Department, the test station in South Dakota was established in the spring of 1958. A committee consisting of one member from each of the eight organized breed associations makes up a swine evaluation station committee. This committee has developed the rules and regulations used in the operation of the station.

The primary objective of the South Dakota Swine Evaluation Station is to help the purebred breeders evaluate potential breeding animals by supplying information they can use in herd improvement, which ultimately leads to improvement of the entire swine population. The commercial producers, who produce most of our market hogs, can then be supplied with information which will aid them in selection of their boars and improvement of their market hogs.

Twenty-four pens are in the South Dakota station, which is located at Brookings. Each test pen entry consists of three boar pigs, which are from three different litters but all from the same sire, plus a barrow that is a littermate to one of the boars. The test pigs are fed on a standard growing-finishing ration under similar environmental conditions. Under these uniform conditions and feeding for maximum gains, the differences in performance may be due largely to inheritance except for differences in pre-test treatment which cannot be accounted for nor standardized.

Collect Performance Data

The performance data collected on the boars are rate of gain and feed required per pound of gain from an initial weight of 60 pounds up to a final weight of 200 pounds, and backfat probe at 200 pounds. The backfat probe is a measure of the amount of backfat on the live animal. This measurement is made by making a small incision in the skin and inserting a steel rule through the fat until it reaches the loin muscle. Measurements are made just behind the shoulder, last rib and last lumbar vertebrae. An average of these three measurements is then used as the average backfat probe.

In addition to these data, the barrow in each pen is slaughtered at a weight of about 200 pounds. Carcass information obtained includes carcass yield, length, backfat, size of loin muscle, and percentage of four lean cuts (ham, loin, picnic shoulder and boston butt).

A summary of data by breeds is presented in Table I. Because of differences in numbers of animals tested within each breed some data included on this table may not give a true picture of the merits of the breed. Generally you will find more difference within in a breed than between breeds. It is a known fact that outstanding bloodlines with good gaining ability and meatiness are found in all the purebred breeds in South Dakota. Data such as this collected at testing stations and that which various breeders collect on their farms will provide assistance in selecting the most outstanding animals in each breed.

Table I.
Data Summary by Breeds
All Breeds 11 Seasons

	Duroc	Landrace	Poland	Yorkshire	Hampshire	Spot	Berkshire	Chester White
Number of seasons	11	6	11	11	10	11	3	10
Number of boars	61	24	81	131	97	63	8	37
Average daily gain, lbs.	1.97	1.82	1.82	1.91	1.82	1.89	1.70	1.82
Average feed/cwt., lbs.	297	306	308	307	306	300	303	302
Average backfat probe, in.	1.15	1.10	1.06	1.08	1.05	1.10	1.06	1.20
Average index	127	120	121	127	123	124	118	114
Number of barrows	24	10	31	46	38	24	3	17
Average carcass length, in.	29.1	30.8	28.8	29.9	29.8	28.6	29.6	29.0
Average carcass backfat, in.	1.57	1.36	1.46	1.57	1.39	1.54	1.39	1.55
Average loin eye area, sq. in.	3.46	4.27	4.54	3.98	4.25	4.16	4.08	3.72
Average lean cuts	50.56	53.36	53.06	51.96	53.90	51.60	52.83	52.00

Sell to Breeders and Producers

At the completion of the test period, boars that have met certain requirements are offered for sale to breeders and producers. As testing continues, the standards have become more strict. If a boar does not meet any one of the performance requirements he is castrated, preventing the use of inferior animals in breeding herds. Performance standards presently required are as follows:

Av. daily gain, lbs.	1.65 minimum
Feed per 100 lbs. of gain.	310* maximum
Backfat, inches.	1.30 maximum
Index.	105 minimum

*Because more feed is required per unit of gain in the winter this requirement is adjusted to a 325-pound maximum for fall trials.

A summary of the average sale price for all sales, the average price received by breeds, and the number of breeders participating is listed in Table II.

Two methods of calculating indexes were used:

I. Boars with half-brother barrows: Index = 240 + 50 (gain) - 50 (feed efficiency) - 50 (probe).

II. Boars with littermate barrows: Index = 117 + 50 (gain) - 50 (feed efficiency) - 40 (probe) + 3 (ham-loin percentage).

Carcass cut-out figures are given on the barrow only. This barrow is either a full-brother or half-brother to the boars in the same pen. The cut-out figures are used in calculating the index of the littermate boar.

Index examples:

1. For a boar which is a half-brother to the barrow in the pen.

Boars Performance Record

Average Daily Gain, pounds	2
Feed Conversion per pound of gain	3
Backfat probe, inches	1

	240
Add 2 x 50	+100
	340
Subtract 3 x 50	-150
	190
Subtract 1 x 50	- 50
	+140 index

Table II.
Average Sale Price for all Sales

Year	Average Price
1958	$148.77
1959	168.13
1959	105.38
1960	114.92
1960	134.95
1961	125.47
1961	168.21
1962	184.00
1963	122.03
1963	150.52

Total boars sold in ten sales = 448

Average Price Received by Breeds

Breed	Number different breeders who have participated	Number boars sold	Average Price
Yorkshire	15	113	$164.38
Hampshire	16	85	158.88
Poland China	10	77	118.47
Spots	9	58	135.78
Duroc	11	53	136.08
Chester White	8	35	115.57
Landrace	4	19	109.32
Berkshire	1	8	113.75

Average price received for all boars sold = $141.34

2. For a boar which is a full-brother to the barrow in the pen.

Boars Performance Record

Average Daily Gain, pounds	2
Feed Conversion per pound of gain	3
Backfat probe, inches	1
Ham-loin percentage of barrow (based on chilled carcass weight)	38

	117
Add 2 x 50	+100
	217
Subtract 3 x 50	-150
	67
Subtract 1 x 40	- 40
	27
Add 3 x 38	+114
	+141 index

Cull Marginal Performers

It is possible for an animal to meet the minimum requirements for gain, feed efficiency, and backfat and still not qualify with an index of 105. The index therefore culls out those animals that are marginal in each of the performance factors, however, its use is mainly for an overall rating for each animal. Besides each of these performance requirements each pig entered must have been from a litter of at least eight pigs weaned and be free from hereditary defects.

A summary for all pigs tested at the South Dakota Swine Evaluation Station is presented in Table III. Of the 577 boars tested, 462 or 80 percent have met the performance requirements. The other 115 boars failed to meet one or more of the performance requirements.

Improves Swine Production

The swine evaluation station is a useful tool in improving swine production. It has pointed out to some swine breeders the performance traits in swine which they need to be improving. Also, good performing lines have been identified and may then be used more extensively to produce a product the consumer will buy. It has also been shown that this type of product can be produced from a hog that gains rapidly and efficiently. It is not difficult to choose between two breeding animals that may look alike when one may have gained 0.75 pound per day faster on 50 pounds less feed per hundredweight of gain. The South Dakota Swine Evaluation Station is helping point the way to improved swine production. Along with "on the farm" swine testing programs, such production will mean more profits for South Dakota Swine producers.

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Table III.
Summary of Data
South Dakota Swine Evaluation Station
1958 - 1963
South Dakota Swine Improvement Association

	Summer 1958	Winter 1959	Summer 1959	Winter 1960	Summer 1960	Winter 1961	Summer 1961	Summer 1962	Winter 1963	Summer 1963
Number of boars entered	72	56	72	36	67	42	70	45	51	66
Number of boars qualified	53	39	63	31	52	37	60	35	40	52
Average daily gain, lbs.	1.86	1.89	1.82	1.83	1.79	1.84	1.84	1.80	1.76	1.82
Average feed per cwt. gain lbs.	300	331	289	319	299	314	291	297	319	301
Average live backfat probe in.	1.22	1.10	1.09	1.10	1.07	1.14	1.14	1.07	.96	1.14
Average index	114	111	127	114	124	120	124	132	122	123
Number of barrows	24	19	24	12	23	14	24	15	17	23
Average carcass length, in.	29.4	28.8	29.7	28.8	30.1	29.1	29.5	29.8	29.4	29.7
Average carcass backfat, in.	1.58	1.51	1.55	1.50	1.53	1.31	1.54	1.45	1.42	1.54
Average loin eye area, sq. in.	4.21	4.46	4.11	4.05	4.16	4.77	3.81	3.98	4.14	3.70
Average percent 4 lean cuts	52.0	52.2	52.4	50.7	52.8	52.4	52.5	51.5	55.7	52.7

Swine Housing and Management in Confinement Production Systems

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Confinement production of swine is not necessarily suited to all producers, and, in part, may in certain instances be undesirable. It does, however, offer the advantage of greater production potential per unit of labor expended through maximum use of mechanization and automation. In addition, confinement protects the animals from the environmental extremes which cause wide variations in level of performance.

Deterrants to confinement swine production have largely involved disease buildup and the difficulties associated with manure disposal. Since their introduction in the early 1950's, antibiotics have been a valuable aid in preventing disease buildup, but handling and disposal of the large volumes of hog wastes have frequently continued to be major obstacles. Mechanical means of cleaning--scraping (by hand or tractor scrapers), water pressure, gutter-cleaner equipment, and various combinations of these--reduced total manual labor but in many cases accentuated the inadequacy of collection and/or storage units. This latter problem deterred many producers from changing from pasture programs and their "built-in manure disposal system."

Most of the housing and management systems developed during recent years involve the following buildings:

1. Farrowing unit - usually completely insulated, tightly enclosed to provide the exacting environment required by the newborn pig.

2. Nursery unit - the term is used here to describe the housing for pigs from the time weaned at 3-to-5 weeks of age until 60 to 75 pounds in weight. Frequently less elaborate than a farrowing unit, but insulated and tightly enclosed, special care to provide warm, draft-free environment. One to five litters per pen.

3. Growing-finishing unit - designed for pigs from weaning at six to eight weeks (30 to 40 lb.), or from a nursery unit, to market weight. Building is usually enclosed, partially or completely insulated. Number of pigs per pen varies with size of animals.

4. Farrow-to-finish unit - design and construction provides for environments suitable for farrowing and for the finishing period.

Thus, a management system may involve from one to three different units during the period from birth to market weight.

An additional unit would be for the breeding herd. In a majority of the cases, this will mean the use of open-front or portable sheds in dirt or pasture lots. A few very specialized producers keep the breeding herd in strict confinement.

[1/]Presented at the Seventh Annual Swine Day, South Dakota State College, Brookings, November 21, 1963.

Many modifications of any one or all of these systems can be found, but of primary concern in each case is maximum utilization of all units commensurate with good management practices.

The increase in size and number of confinement swine production units has been markedly influenced by the introduction of slotted floors. These "self-cleaning" floors employ the structural concept of providing openings in the floor through which manure will drop or be trampled. When properly managed, these floors essentially eliminate the time and labor of regular cleaning frequently associated with solid floors. Slat describes a fabricated material of long narrow dimension and when spaced at appropriate intervals, provides a slotted floor. Non-slat materials, such as flattened expanded metal having diamond-shaped openings, also provide the "self-cleaning" principle.

Slotted floors have reportedly been used in sheep housing in Iceland for over 200 years! However, they have been incorporated into swine housing design in the United States only within the last three years.

Closely associated with the effective and efficient use of slotted floors is the waste disposal pond or lagoon. The manure is retained under the slotted floor or in collecting tanks for later removal to fields, or in many cases is drained directly into a logoon. This latter approach may seem an economic waste, but the fertilizer value is frequently considered insufficient to pay for the labor and facilities necessary to deliver it to the fields.

It must be recognized that slotted floors represent but one part of the building design, and their effective use is dependent upon and only as good as the management being exercised. From research and other observations, many factors have been shown to affect behavior and performance of swine in confinement. And from the management viewpoint, flooring material and design must satisfy two basic requirements: (1) minimize labor expended per animal unit, and (2) cause no adverse effects on the well-being and total performance of the individual animal. In these respects, many different arrangements have proven satisfactory under specific circumstances.

Floor Design

Partially slotted floors have slat-covered gutters, and the surface area ratio of solid floor to slotted area runs about three to four to one with the solid portion sloping toward the slat-covered gutter. Under optimum conditions the slotted area serves as a dunging area and cleaning chores are at a minimum. Locating the water on the wall side of the gutter or over the gutter encourages desired behavior patterns. Floor space per pig and season are two factors important in keeping these pens clean, "housekeeping" usually being easier during cool weather. Pen shape has generally been narrow and long, and of 8- to 20- pig capacity.

On-floor feeding is very suitable to partially slotted floor pens since the feed can be placed on the solid portion, usually the sleeping area. This helps maintain cleanliness in pens since pigs seem to refrain from dunging in the eating and sleeping area. Feed wastage is at a minimum if the animals do not have more feed available than they will consume at one eating. And this can be accomplished by correct use of the recently developed feeder systems permitting automatic feeding of specified quantities at prescribed intervals of time.

Completely slotted floors. On completely slotted floors pen shape is apparently of little concern to the pig, and can frequently be designed for convenience of the operator. A one-inch or two-inch slot should be left next to walls or partitions to reduce area of potential manure buildup.

The on-floor type of feeding program can be followed by allowing enough trough space for each animal, and making the pen deep enough to provide the necessary floor space. A solid strip under the trough, or a feed-saving lip as part of the trough, should be used to prevent loss of feed through the slots. Liquid feeding could be readily adapted to this system.

Floor Materials

Wood, concrete, steel masonite board and other materials have been evaluated. Completely enclosed buildings have usually been used, although open-front sheds have been employed in moderate climate areas.

Farrowing units - Slotted floors are effectively used under farrowing crates with many different arrangements being evaluated. Frequently a solid floor area, 2' to 4' wide, is used across the crate to provide sleeping area for the baby pigs. Slotted floor "porches" attached to portable individual houses have been effectively used for sows and litters on pasture, the units being moved as dictated by manure buildup under the slats.

Nursery units - Flattened expanded metal, having diamond-shaped openings 5/8 inches x 1 1/2 inches, has proved a very effective flooring material for pigs from two weeks of age to 60 pounds in weight. Durability and usable life are limited when exposed to concentrated traffic of heavier animals.

Growing-finishing units - Certain materials have proved unsatisfactory when used in totally slotted floors, but could be used satisfactorily over gutters in partially slotted floors where pigs spent relatively limited time on them.

Slat Width and Spacing

Growing-finishing pigs gained at comparable rates whether on solid concrete, five-inch wide concrete slats spaced one inch apart, four-inch wide wood slats spaced at one-inch intervals, 1 1/4-inch wide wood slats at 1/2-inch intervals, or solid oak floor. However, spacing the 1 1/4-inch wide slats at one-inch intervals adversely affected performance of pigs from 100 to 200 pounds, and with increasing weight the animals became reluctant to move about, evidenced soreness of feet and weakness of legs. Voluntary feed intake was markedly reduced and rate of gain significantly slower than that by pigs on the same slats spaced at 1/2-inch intervals. Uneven heights of slats and variation in spacings contribute to restricted movement of animals.

Space Allowance

Relative crowding of animals on slotted floors is essential to keep (1) the manure trampled through the slots and (2) animals clean. But the extent to which pigs can be crowded without adversely affecting growth rate may depend on many factors, including:

1. Size of animals
2. Number per pen
3. Pen design
4. Ventilation
5. Season--particularly temperature
6. Method and level of feeding

All of these are interrelated. For example, number of pigs per pen is more critical during high temperatures than during cool temperatures. Self-feeding and limited feeding affect rates of gain and could modify minimum space allowances.

On the basis of research at the University of Illinois, the following tentative minimum space allowance on slotted floors are suggested to allow a maximum rate of gain for growing-finishing swine.

Space on Slotted Floors

Weight of animal	Square feet per animal	
	Winter	Summer
25 to 40 lb.	3	3
41 to 100 lb.	4	4
101 to 150 lb.	6	6
151 to 210 lb.	8	9

Current test results indicate space requirements for growing-finishing swine confined to pens having complete concrete floor or partially slotted floor are very similar to those on slotted floors.

Environment Control in Confinement Housing

(a) Temperature and drafts. It is particularly important to provide warm temperatures for young pigs, and in completely slotted floor units drafts cause added stress since the animals have no solid floor sleeping area.

(b) Odor and ventilation. Method of manure handling or length of time manure accumulates may affect ventilation requirements. Although apparently largely immaterial to the pig, odor can become quite offensive to workmen. Rate and pattern of air replacement will modify odor intensity. Buildup of manure and urine under slotted floors results in an as yet incompletely defined gaseous production which will vary with temperature and environment. With mechanical ventilation failure in tightly enclosed buildings, oxygen lack would perhaps be of more concern than accumulation of gases or odors. In a few reports of "slow-up" in growth rate after 150 lb. in weight, accumulation of carbon dioxide has been suspected, but other gases may have been involved. However, it is likely that either inadequate floor space or defective floor material and design was a major factor.

Additional Management Consideration Resulting from Use of Slotted Floors

Advantages

(a) Sanitation - slotted floors aid in sanitation since the animal excreta drops or is forced through the slots, and this reduces direct contact of the animal with material possibly carrying pathogenic organisms and/or parasites.

(b) Labor - daily cleaning chores have been reduced up to 95 percent of that required on solid floors.

(c) Bedding - properly designed and effectively used slotted floors in tightly enclosed, insulated and ventilated units eliminate use of bedding.

Disadvantages

(a) Feed wastage - spilled feed is lost feed since it falls through the slots and cannot be reclaimed by the pig.

(b) Fighting - if different groups of pigs have to be mixed and fighting results, more extensive injury to feet and legs may result than on solid floors.

(c) Cost - initial cost of slooted floors will be greater than for solid floors and with certain materials maintenance may be excessive. This added cost cannot be justified on the basis of an assumed increase in production efficiency, but is more often justified on the bases of labor saved, the possible increases in volume of production because of labor efficiency, at least partial solution to manure handling problems, saving in bedding costs, and convenience to the operator.

Tail biting and cannabalism are apparently no more or less frequent on slotted than on non-slotted floors, management considerations being equal.

Summary

The percentage of the total number of swine produced in the United States that come from confinement systems has increased dramatically during the past three to five years. Unit components of housing systems suitable to specific age and size of animal have been developed. Handling and disposing of waste materials have been greatly facilitated by use of completely or partially slotted floors.

Research to date suggests that total swine performance on slotted floors is comparable to that from animals on conventional floors. Slotted floors, both partially and completely, have been effectively used in housing units for swine of all ages.

Optimum width and spacing of slats varies with size of pig, design and kind of slats. In general, for cleaning efficiency, wide slats are most effectively used in finishing units, with narrow slats more effective in farrowing and nursery units. Narrow slats and wide spacings caused feet and leg injury to finishing (100 to 200 lb.) swine.

Space allowances for growing-finishing pigs have been suggested. Space needs can be affected by factors such as size of pigs, number of pigs per pen, air temperature and method of feeding. Relatively restricted floor space encourages maximum cleanliness of pens and pigs.

Effective use of slotted floors will save labor and improve sanitation. Care should be taken to avoid use of materials having rough or sharp edges or other characteristics that would result in injury to feet and legs. In tightly enclosed insulated buildings bedding has been eliminated.

The ready acceptance and almost immediate use of the slotted floor principle in commercial swine units preceded availability of good research data. While many advantages have been realized, a few new management problems have developed. It should be emphasized that slotted floors can be a strong assist to swine management and a key part of the manure handling and disposal system, but they cannot be expected to replace, or be a substitute for, the good manager.