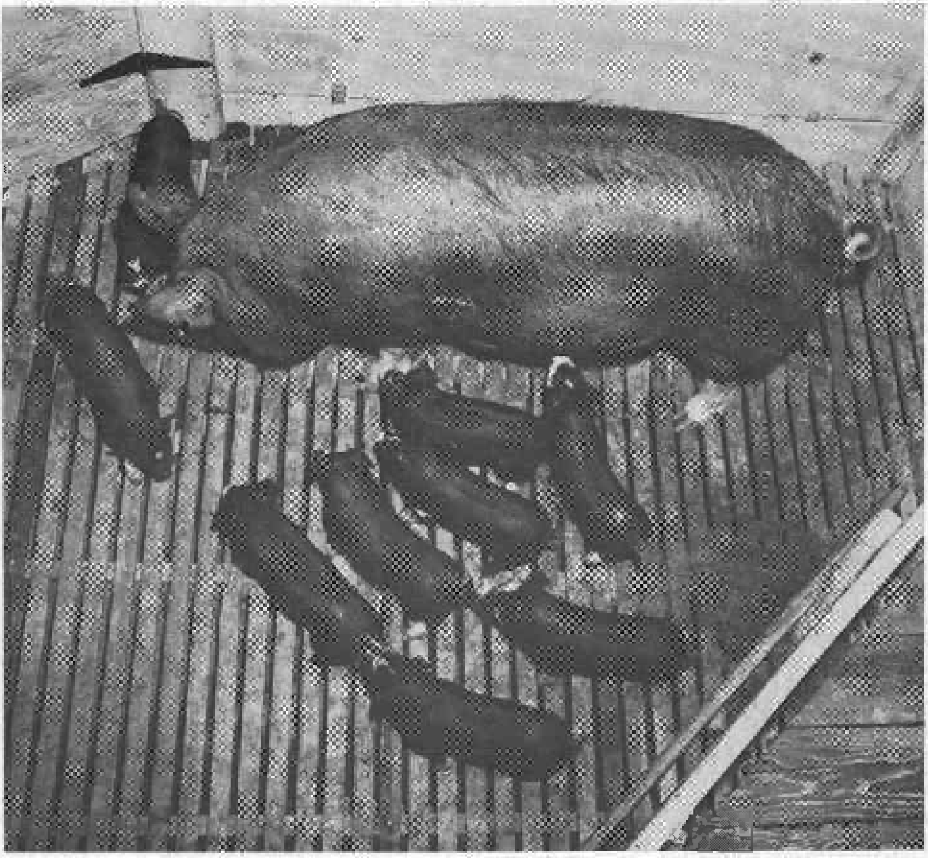
Summary of Reports . . .

Fourth Annual Swine Day



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Department of Animal Science, Oregon State University

And Western Oregon Livestock Association

Contents

The Ohio Pork Improvement Program

W. H. BRUNER

Sixteen years ago leaders in the Ohio pork industry laid plans for today's Ohio Pork Improvement Program. It is an unique educational and improvement program developed by pork producers and others associated in the industry and is carried out through the facilities of the Swine Evaluation Station and the University Meat Laboratory. It is supervised by the Agricultural Extension Service and the Ohio Agricultural Experiment Station. The official governing body is the Ohio Pork Improvement Association of Ohio. Pork producers nominating litters automatically become members.

It is a selection program. The major objective is to aid breeders in locating and recognizing foundation seed stock in Ohio herds that will improve production efficiency and market value of the Ohio hog crop.

The program is not intended to make comparisons between herds and breeds.

Selection of this foundation stock is made on the basis of records that indicate absence of inherited defects, prolificacy, sow nursing ability, rapid growing and gaining ability, efficient use of feed, and superior meat-type carcass.

We like to think of the meat hog as one which:

- Raises at least 8 pigs per litter.

- Reaches a weight of 200 pounds in 180 days or less.

- Makes gain economically on a practical feeding program, that is, 100 pounds of gain from postweaning to market on 340 pounds of feed or less.

- Yields a carcass that is superior in amount and quality of trimmed lean cuts--ham, loin, and shoulder; at least 51.75% of chilled carcass weight (packer style) should be in lean cuts.

Management, rations fed, and environment affect performance records. These factors tend to be uniform at a testing station during a given season.

The Ohio program is a tool available to breeders who want to improve their herds. It is a part of the overall pork improvement program. The overall program includes breed production registry and meat certification, barrow and carcass shows, etc. Breeders are encouraged to do breed certification.

Since spring of 1948 and through fall of 1961, 250 breeders have evaluated 2,157 litters as to litter size, rate of gain, feed utilization, and carcass merit. Over 4,200 carcasses, with an average chilled carcass weight of 150 pounds, have been evaluated.

From the start of the Ohio program, we have been interested in pounds of lean cuts of chilled carcass weight and/or primal cuts of live weight. We are now only using percent lean cuts of chilled carcass weight for certification. Other characteristics studied are: backfat thickness, loin eye area, carcass length, and ham and loin percent of chilled carcass weight.

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Procedure for Station participation

1. A breeder nominates litter within 10 days after farrowing on a prescribed form and mails it to the secretary of the association, along with a $2 fee.

2. Weight standards of 21, 35, or 56 days prescribed by the Pork Improvement Association apply.

3. A representative pair of pigs is selected from a litter that has met weight standards (barrow and gilt if possible). (Breeder, county agent, vocational agriculture teacher, or appointee to weigh and make selection).

4. Pigs entering the station must be treated for cholera and erysipelas and accompanied by a health certificate. (Inspection of herd by local veterinarian.)

5. Male pigs should be castrated.

6. Breeder delivers pair of pigs to the station by or before they are 60 days old.

7. Entrance fee for a pair of pigs per litter is one pig. The other pig is purchased at 1½ times the market price times the average weight of the two pigs.

8. Pigs are self-fed standard ration and started on feed at 63 days of age. Starting and finishing rations carrying approximately 15½% and 13½% crude protein, respectively, are used.

9. Pigs are weighed individually at biweekly intervals.

10. Test ends as each pig reaches 210 pounds in weight.

11. Both pigs are slaughtered at Ohio State University Meat Laboratory and detailed carcass data obtained.

Certification standards: (Certification of record on remaining boars and gilts in litter):

1. Feed standard is 340 pounds of feed or less per 100 pounds gain while on test.

2. Each pig of the pair must average 200 pounds at 180 days.

3. An average lean cut yield of 51.75% and over with neither pig cutting less than 51.25% is certified Ohio Superior.

4. Certificates are issued by certification committee selected from the membership.

5. Data on certified litters is released periodically, giving breeder, breed, litter index number, rate of gain, feed utilization, and carcass value.

Analysis of results: Records of pigs certified Superior and compared to pigs that were too fat are shown in Table 1.

Table 1. Production and carcass data

Ten seasons 1954 F through 1959 S	Meat-type certified Ohio Superior	Over fat or low lean cut yield Noncertified
Number of animals	702	154[1]
Starting weight (lbs.)	42.6	41.0
Age at 210 lbs. (days)	162.5	162.6
Feed required per 100 lbs. gain	333.2	353.3
Backfat (in.)	1.51	1.82
Carcass length (in.)	30.1	29.4
Loin eye area (sq. in.)	3.96	3.28
Percent lean cuts of chilled carcass weight	52.43	47.09
Percent fat trim of adjusted live weight	14.99	19.23

[1] Both pigs of pair were over fat (77 pairs). Thirty-three pounds of feed saved per hog from starting weight to off-test weight.

Table 2. Weight of selected cuts

Eight seasons 1954 F through 1958 S	Meat-type certified Ohio superior	Over fat or low lean cut yield Noncertified
Pounds of skinned ham	29.48	26.49
Pounds of trimmed loin	23.85	20.65
Pounds of N. Y. shoulder	25.82	23.71
Pounds of trimmed belly	22.83	23.51
Pounds of fat trim	31.08	38.73
Slaughter weight (lbs.)	201.7	202.0

In further study of these two groups a comparison was made of weights of selected cuts (Table 2).

Certified meat-type carcasses yielded 8.3 pounds more lean meat and 7.7 pounds less fat trim than noncertified.

A number of correlations between characteristics have been made and are given in Table 3.

Pounds of skinned ham, pounds of trimmed loin, and loin eye size in both barrows and gilts were more closely correlated than either carcass length, backfat, or daily gain with lean cuts of carcass weight. There seems to be little correlation between daily gain and loin eye size or backfat thickness.

Combining the two characteristics of ham and loin weights with lean cuts, a correlation of .95 is obtained in both barrows and gilts.

This data indicates a high degree of accuracy by using pounds of skinned ham and pounds of trimmed loin in predicting carcass value.

Comparing carcass characteristics with age at slaughter (1954 fall through 1960 spring seasons) we have found barrows tend to gain faster than gilts as indicated by days of age at 210 pounds.

Age at 210 pounds does not seem to affect backfat thickness, carcass length, loin eye size, or percentage lean cuts in barrows.

Gilts tend to produce leaner, meatier carcasses than barrows as shown by backfat thickness, loin eye size, and percentage lean cuts.

As gilts get older, the loin eyes of their carcasses tend to be larger and the percentage lean cuts greater.

Table 3. Ham and/or loin weight correlate closely with lean cuts[1]

	Range	
	Barrow	Gilt
Lbs. of skinned ham and lbs. of lean cuts	.79 to .88	.83 to .89
Lbs. of trimmed loin and lbs. of lean cuts	.74 to .86	.67 to .83
Loin eye size and lbs. of lean cuts	.61 to .71	.56 to .76
Backfat and lbs. of lean cuts	–.13 to –.51	–.11 to –.47
Carcass length and lbs. of lean cuts	–.02 to .27	–.15 to .33
Daily gain and lean cuts	–.28 to .11	–.04 to –.41
Daily gain and backfat thickness	–.11 to .15	–.09 to .33
Daily gain and loin eye size	–.26 to .15	–.39 to .28

[1] (8 seasons) 1954 fall through 1958 spring 659 full sibs (barrow-gilt).

In another study involving 385 full sibs, the following observations were made:

	Barrows	*Gilts*
Loin eye area (sq. in.)	3.46	3.97
Carcass length (in.)....	29.76	30.17
Backfat thickness (in.)	1.66	1.56
Percent lean cuts of chilled carcass wt.	49.28	51.58

A study of five seasons (1959 spring through 1961 spring) of barrow, gilt, and boar littermate data is reported in Table 4. Breeds represented were Berkshire, Duroc, Hampshire, Landrace, Poland China, Spotted, Chester White, and Tamworth.

Littermate boars and barrows had about the same rate of gain, while littermate gilts tended to be slower in rate of gain. Starting with the 1962 spring season only boars from certified matings are being evaluated. Two boars from a certified mating are individually fed to determine rate of gain, feed utilization, and backfat probe.

Marketing and merchandizing

Several problems are involved in marketing and merchandising meat hogs.

1. Efficient marketing includes topping out.
2. The genuine meat hog marketed at 200-220 pounds under the present wholesale merchandising system may have skinned hams and trimmed loins too heavy to command top price.
3. Processor requirements vary by section of the country.
4. Carcass measurements, carcass grades, and lean cut yield do not always coincide.
5. Lack of volume has been and continues to be a major problem for processors and retailers in merchandising meat-type carcasses.
6. More merit buying is needed in which value differences of individual hogs or lots of hogs are recognized. Many markets today are buying hogs on merit and thereby reflecting back to the producer price differentials based on quality.

Table 4. Barrow, gilt, boar, and littermate data

	1959 spring 21 litters[1]			1959 fall through 1961 spring 45 litters[1]		
	Gilts	Barrows	Boars	Gilts	Barrows	Boars
Daily rate of gain (lbs.)[2]	1.58	1.69	1.70	1.80	1.96	1.96
Feed required per 100 lbs. gain (lbs.)[3]	321.8		302.7	288.2		266.3
Backfat thickness (in.)	1.48	1.54		1.53	1.60	
Live backfat probe (in.) (Adjusted to 200 lbs. live wt.)			1.15			1.23
Percent lean cuts of chilled carcass wt.	52.49	50.12		52.13	50.44	

[1] Barrow, gilt, and two boars per litter.

[2] Barrows and gilts off test at approximately 210 pounds and boars off test at approximately 200 pounds. Started at 63 days of age. Barrows' and gilts' average starting weight was 46.3 pounds; boars' average starting weight was 48.7 pounds.

[3] 1959 spring—feed self fed as a complete meal. Growing ration from 63 days of age until pigs averaged approximately 120 pounds was calculated to have 15.5% crude protein. Finishing ration fed from 120 pounds until pigs were taken off test was calculated to have 13.6% crude protein.

1959 fall through 1961 spring—protein levels of rations were calculated to be the same as in 1959 spring; however, the feed was pelleted. Boars require less feed per 100 pounds gain than did barrows and gilts.

In summary, the meat-type hog with inherent ability to grow muscle is an efficient producer of quality lean pork. Much progress has been made but one of the major problems today is increasing the supply of meat hogs marketed on a merit system. Each segment of the industry has an important role to play.

Results of the program

Some of the results of the Ohio Pork Improvement Program are as follows:

- Growing interest among breeders as indicated by increased participation in the program. Since 1954 approximately 250 breeders have participated.
- Changing attitude on the part of pork producers as breeders report that their clients now demand boars from certified litters.
- Production of at least 200,000 market hogs annually in Ohio by boars from certified litters. Since the program has demonstrated that net return on such hogs is increased by about $2 per head through higher market prices and lower feed requirements, it is estimated that an increase in net income of about $400,000 annually is received by Ohio farmers.

These are a few tangible results of an educational effort and direct assistance rendered to Ohio pork producers through this project.

Purebred and commercial pork producers have a fine, constructive attitude and are taking pride in striving to produce quality lean pork efficiently. This is somewhat intangible but it gives us a great degree of satisfaction.

Improvement of Reproductive Performance in Swine

VERNE M. CHAPMAN and DAVID C. ENGLAND

One of the unique features which distinguishes swine from other classes of farm animals is the multiple birth character of reproduction. Multiple births are an important economic advantage to the producer of swine and make possible a yield of salable product per breeding unit which exceeds the capabilities of other classes of farm animals. Inasmuch as the reproductive performance of the sow; e.g., the size and vigor of the litter farrowed, establishes the base from which the ultimate yield is determined, the producer must continually strive to improve this trait.

Coupled with this important advantage of multiple births are problems which are not found in those species where fertility is expressed merely as the percentage of females exposed for breeding that reproduce. In swine the breeder and producer is faced with a continuous distribution of the number of pigs within litters. Litters vary from 1 to 17 or more pigs. In addition to differences in number born, the swine producer also encounters a variation or lack of uniformity of birth weights both within and between litters. The importance of this variability of birth weights is shown in Table 1. From these data, compiled from records of the OSU swine herd, it can be seen that pigs which weighed less than 2 pounds at birth showed lowered viability and decreased weaning weights. Studies by Pomeroy (1960) and Vestal (1938) show a similar incidence of pigs of this size and comparable figures of survival and weaning weights. Stillborn and mummified fetuses occur frequently enough to be of concern.

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OSU Farrowing records

The following report and discussion of reproductive performance in sows is based upon the findings of a recent study of farrowing records of the Oregon State University swine herd. The

Table 1. The effect of birth weight on post-natal survival and weaning weight

Birth weight	No. born	Percent of population	Percent survival	Average weaning weights
lbs.				*lbs.*
.... - 1.9	167	8.0	32.3	27.8
2.0 - 2.4	360	17.2	62.7	31.9
2.5 - 2.9	575	27.6	71.1	35.0
3.0 - 3.4	588	28.2	75.0	37.3
3.5 - 3.9	300	14.4	74.3	37.2
4.0 -	92	4.4	82.6	39.8
Total	2,082	100	Av. 68.5	35.56

purpose of this report is to relate some of the implications of this study to the development and use of management and selection procedures which will improve reproductive performance in swine. In this study four components of reproductive performance were analyzed. These are litter size, average birth weights, uniformity of birth weights within litters, and number of pigs born dead. Findings were examined in the light of work previously conducted in the field of reproduction.

Scope of the study

One of the primary purposes of this study was to determine the consistency of a sow's performance in relation to the performance of other sows in the herd or to determine the degree to which sows expressed a characteristic pattern of reproduction. With this knowledge it will be possible to determine whether selection for increased uniformity of birth weights within litters will decrease the incidence of low birth weight pigs.

Secondly, the study determined the likelihood of a sow passing a similar level of performance to her daughters. The latter is most commonly referred to as heritability, while the consistency of reproductive performance in the same animal is called repeatability. These are expressed in terms of the percentage of the time a sow will probably pass on to her offspring a similar level of performance or the percentage of times she will tend to perform as she did previously.

Also included in this study were analyses of the effects of litter size, litter weight, and age of sow upon uniformity of birth weights within a litter; the effect of age of sow upon litter size; and the effects of age of sow and litter size on the mean birth weight of a litter and the number of pigs born dead in a litter.

Results

Results of this study show that there tends to be less uniformity of birth weights within litters as the size of litter increases. In some studies (Lush and Molln, 1942; Waldorf, et al., 1958; and Olbrycht, 1943) litter size has increased with increasing age of sow (up to 3 years). From this it might be expected that the litters from older sows would be less uniform because of their increased size; however, no prominent age-of-sow effects were observed upon this character.

Estimates of repeatability of uniformity of birth weights was very low and indicated that a sow tended to express a similar uniformity of birth weights in her litter about 2% of the time. The data in Table 2 show the farrow performance of seven sows of the Oregon State University Berkshire herd. Sows 53-131, 53-132, and 53-134; and sows 54-68, 54-69, and 54-71 comprise two groups of littermate sows. Both of these littermate groups are out of the same dam and by the same boar. Sow 54-13 is a half sister to the other sows. Data in the table show the total number farrowed, number farrowed alive, average birth weight of the litter, and uniformity of birth weights within a litter (the smaller the figure the greater the uniformity).

Lack of consistency of uniformity of birth weight between successive litters can be observed in this group of sows.

The estimate of repeatability of litter size was 0.20. Literally this means that a sow may be expected to retain, on the average, 20% of the difference between her performance and the per-

Table 2. Successive farrowing records of 7 sows of the OSU swine herd

	Littermates[1]				Littermates		
	53-131	53-132	53-134	54-13	54-71	54-69	54-68
Born alive	11	11	12				
Total born	11	13	12				
Av. weight (lbs.)	2.50	2.47	2.44				
s^2*	.038	.293	.613				
Born alive	9	10	10	9	11	6	7
Total born	10	10	13	9	11	6	8
Av. weight (lbs.)	2.87	2.92	2.72	2.17	2.95	3.27	3.14
s^2	.324	.467	.211	.335	.221	.070	.077
Born alive	7	10	10	9	12	9	9
Total born	10	11	11	9	13	11	10
Av. weight (lbs.)	3.14	2.95	2.73	2.77	2.65	3.06	3.27
s^2	.224	.323	.184	.222	.179	.167	.070
Born alive	8	10	13	10	13	9	6
Total born	11	11	14	11	14	9	7
Av. weight (lbs.)	2.92	3.27	2.86	2.30	2.84	3.06	3.19
s^2	.152	.580	.684	.950	.328	.340	.225
Born alive	8	7	12	10	9	11	9
Total born	8	10	13	10	9	12	9
Av. weight (lbs.)	3.30	3.23	3.08	2.82	3.39	2.98	3.39
s^2	.086	.369	.507	.107	.159	.451	.159
Born alive	9	9	10	9	8	9	
Total born	9	9	10	9	8	9	
Av. weight (lbs.)	3.07	3.78	3.04	2.69	3.06	3.40	
s^2	.165	.055	.336	.469	.397	.149	
Born alive	7	6	9	9	8	10	
Total born	8	9	13	10	8	10	
Av. weight (lbs.)	2.90	3.58	3.13	2.38	3.08	3.26	
s^2	.537	.190	.341	.472	.473	.436	
Born alive	7	8	12	10	11	9	
Total born	8	11	14	11	13	9	
Av. weight (lbs.)	2.90	3.14	2.38	2.26	2.84	3.14	
s^2	.617	.223	.809	.411	.324	.198	

[1] Sows 53-131, 53-132, and 53-134; and sows 54-68, 54-69, and 54-71 are two littermate groups by the same sire and dam in successive seasons. Sow 54-13 is by the same sire as the rest of the sows.

* S^2 The smaller this figure the greater the uniformity of birth weights. This is derived from the average difference or deviation from the mean birth weight squared.

formance of another sow in subsequent litters.

Unlike studies reported by Lush and Molln (1942), Olbrycht (1943), and Waldorf et al. (1957), no consistent increases in litter size were observed as the sows became older. This suggests that this factor varies in its importance between different breeds and herds of swine and that a producer should be familiar enough with his own sow production records to know the importance of this factor within his own herd.

Estimate of heritability of litter size was about 20% in this study which is comparable to estimates ranging from 15 to 20% in other studies. The meaning of this figure is heritability can be best expressed by an example. . . .

A producer has a herd of sows which average nine pigs farrowed. He selects replacement gilts from a group of sows in the herd which average 11 pigs farrowed. With a heritability of 20% and assuming that the boar's genetic potential is the same as the selected sow's genetic potential, he can expect replacement gilts to average 20% of the difference between the herd average and the average of the selected sows. That is, he can expect 20% of the two-pig difference or an average of 9.4 pigs farrowed in the replacement gilts.

The average birth weight of a litter decreased as litter size increased. There was also a tendency for larger litters to contain more dead pigs. Neither of these factors was significantly influenced by the age of the sow.

Repeatability and heritability estimates also calculated for the weight of the litter farrowed were 13.4 and 20.0%, respectively. These figures were comparable to the estimates derived for repeatability and heritability of litter size.

Implications

What are the implications of this study to swine production? First of all, low estimates of repeatability of reproductive traits in swine indicate that the producer or breeder should avoid culling a sow on the basis of a single record of performance and that he should utilize a sow's total record in considering her breeding value. The same is true in selecting replacement females. Here it is important to examine the sow's overall record and if possible the performance of her previous progeny before selecting her progeny for herd replacements.

Furthermore, low estimates of repeatability and heritability suggest that levels of performance of these traits are markedly influenced by temporary environmental factors such as stress due to temperature, fighting with other sows, and general rough handling during gestation. Improper feeding and degree of fatness have been shown to seriously influence reproduction (Rathnasabapathy et al., 1956). Therefore, by better understanding the needs of the sow and by exercising the best possible husbandry it should be possible to decrease variability of reproductive performance of sows and more accurately identify those individuals which offer the greatest genetic potential for reproduction. When this is accomplished more effective selection for improved reproductive performance will be possible.

Goal of performance

In general, the desired goal of swine reproductive performance is twofold; that is, a litter should contain (1) a "maximum" number of pigs and (2) strong healthy pigs as indicated by birth weight. The use of the term "maximum" number of pigs per litter is somewhat ambiguous in light of some popular concepts that a sow can have too many pigs. Many sources suggest that more than 12 pigs per litter are not desirable because of the sow's inability to adequately suckle more than this number. An opposing viewpoint held by the authors is that, although large litters may result in increased numbers of smaller pigs which cannot adequately cope with conditions normally found in present day swine operations, the producer should look to the future. Management technology and nutritional knowledge has markedly improved during the past decade and will probably continue to do so at an increasing rate. Studies conducted at this station (England, Chapman, and Bertun, 1961) with artificial rearing of small sized pigs show that these pigs are capable of survival and growth in a suitable environment. The result of this increased knowledge will be an increased degree of artificial rearing to help the sow in meeting early life needs of the pigs. Furthermore, if swine are to retain their favorable competitive advantage, the producer must seek to improve litter size to the very biological limits; that is, if a sow is capable of producing 16, 18, or even 20 viable pigs, then the producer must seek to obtain that number.

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Different Levels of Alfalfa in Rations for Growing Hogs

J. E. Oldfield, D. C. England, T. P. Davidson, and Robert Cooper

For many years, alfalfa has been used as a ration component for growing market hogs—but usually at low levels. At such levels it has performed creditably and has added significantly to the vitamin and trace mineral content of the diet. Alfalfa is, however, high in fiber and there has been some question about feeding higher levels since fiber is digested only with difficulty by hogs. On the other hand, some advantage of increased fiber levels has been shown during the finishing stages for market hogs in producing a leaner-type carcass. Added to this are the potential economic advantages in using alfalfa in place of other more expensive feed ingredients.

The experiment reported herein was designed to test the effects of three different levels of alfalfa (10%, 20%, and 30%) in otherwise balanced swine rations involving three different grain sources: barley, milo, and corn. The experiment was conducted at the Umatilla Branch Experiment Station at Hermiston during winter of 1961-62, using producer-owned pigs.

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Experimental procedure

Nine groups of eight pigs each composed of both barrows and gilts were allotted to ration treatments as shown in Table 1.

Table 1. Ration treatment

Ration	Grain source	Alfalfa
		%
1	Barley	10
2	Barley	20
3	Barley	30
4	Milo	10
5	Milo	20
6	Milo	30
7	Corn	10
8	Corn	20
9	Corn	30

Previous environmental effects were equalized among the pigs by allotting one pig from each of eight producer groups to each ration treatment. Animals were individually identified by ear notches; weight gains and carcass data were recorded on each pig. Pigs on each ration treatment were group fed; feed efficiency calculations are therefore on a group basis. Identical housing was provided for each treatment and consisted of an 8′ by 16′ pen having a cement floor and a roof extending over half the area. A wood pallet under the roof served as the bedding area. Automatic waterers and self-feeders were provided in each pen and all rations were fed in pellet form. The composition of the various rations is listed in Table 2.

Table 2. Composition of experimental swine rations

	10% alfalfa			20% alfalfa			30% alfalfa		
	Barley	Corn	Milo	Barley	Corn	Milo	Barley	Corn	Milo
	lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Grain	1,560	1,560	1,660	1,400	1,400	1,460	1,260	1,260	1,260
Herring meal	100	100	100	100	100	100	100	100	100
Ground alfalfa	200	200	200	400	400	400	600	600	600
Soybean oil meal	100	100		60	60				
Steamed bone meal	20	20	20	20	20	20	20	20	20
Trace mineral salt	20	20	20	20	20	20	20	20	20

* Each ration contained 100 ppm added zinc and 30 gms/T antibiotic.

Protein content of the rations was brought up to the same level in all rations by adding soybean meal to rations having the two lower levels of alfalfa. This was necessary in the case of the corn and barley rations but not in the milo ration with the particular grains used in this study.

Results and Discussion. All rations were eaten well by the pigs and reasonable gains were made. Test results are shown in Table 3 for each ration treatment and averaged for the different grains and for the different levels of alfalfa feeding.

Table 3. Performance of swine fed balanced rations with different grains and different amounts of alfalfa

Grain	Percent alfalfa	Av. daily gain	Feed per lb. gain	Carcass length	Backfat thickness	Loin eye area	Feed cost/ lb. gain*
		lbs.	*lbs.*	*in.*	*in.*	*sq. in.*	*dollars*
Barley	10	1.65	3.77	30.6	1.39	3.87	0.121
Barley	20	1.52	4.19	30.8	1.26	3.48	0.128
Barley	30	1.35	4.47	31.0	1.17	3.58	0.130
Milo	10	1.66	3.56	30.8	1.42	3.79	0.107
Milo	20	1.69	3.75	30.9	1.32	3.79	0.110
Milo	30	1.55	4.16	31.0	1.25	3.44	0.118
Corn	10	1.72	3.89	31.0	1.57	3.53	0.131
Corn	20	1.59	4.19	30.9	1.50	3.16	0.135
Corn	30	1.50	4.35	30.8	1.33	3.55	0.132
Av. all 10% alfalfa		1.68	3.74	30.8	1.46	3.73	0.120
Av. all 20% alfalfa		1.60	4.04	30.9	1.36	3.48	0.124
Av. all 30% alfalfa		1.47	4.33	30.9	1.25	3.52	0.127
Av. all barley		1.51	4.11	30.8	1.27	3.64	0.126
Av. all corn		1.60	4.11	30.9	1.47	3.41	0.133
Av. all milo		1.63	3.82	30.9	1.33	3.67	0.112

* The feed cost per pound gain is based on actual cost of the rations and would, of course, vary with different sources of feed supply.

Several items of interest emerge from these results. Considering the different alfalfa levels first, it is obvious that, as expected, feeding larger quantities of alfalfa resulted in decreased daily gains and also decreased backfat thickness in the carcasses. While there are no marked differences in cost of feed per pound of gain, nevertheless it is interesting that increasing amounts of alfalfa did not show a tendency to lower costs. This situation reflects the comparative prices of alfalfa and grains in the area where the test was conducted. Use of elevated levels of alfalfa would be indicated when it could be supplied at a cheaper cost than grains. Although there was a marked decrease in backfat thickness as alfalfa levels increased, there was not a corresponding increase in the loin eye area.

Comparison of the averages of rations containing the different grains indicates little difference between performance on corn and milo rations as regards average daily gains but slightly lower gains on barley rations. This again is to be expected, since barley rations contain additional hull material which is not utilized by the pig. Just as increased levels of alfalfa in the rations resulted in leaner carcasses, so did presence of barley in the rations, by adding fiber, decrease backfat thickness. Comparative prices of the three grains at the time this test was made favored the inclusion of milo. Such price relationships vary considerably from time to time and should be checked out under any given set of conditions.

As might be expected, feed required per pound of gain and cost per pound of gain were closely correlated and these in turn were related to rate of gain. Although alfalfa was actually a cheaper feed, it produced slower gains than the higher grain rations and the cost per pound of gain was increased when higher amounts of alfalfa were added.

Generally speaking, the carcass quality of all of the animals was good. All except 4 of the 72 carcasses met U. S. No. 1 backfat thickness standards. Three of the four that did not were on corn rations.

Summary

1. Three levels of alfalfa (10%, 20%, and 30%) were tested with three different grains: barley, milo, and corn in rations for swine.

2. As the alfalfa content of the rations was increased, rate of gain and backfat thickness decreased.

3. Corn and milo rations produced essentially equal gains but barley produced slightly lower gains than the other two cereal grains.

4. Barley rations produced slightly leaner carcasses than did milo or corn rations.

5. Milo rations produced slightly more economical gains, based on feed prices at the time of this test.

Scours in Suckling Pigs—Characteristics, Effects, and Treatments

DAVID C. ENGLAND and VERNE M. CHAPMAN

During the past several farrowing seasons in the OSU swine herd there has occurred a late-developing type of scouring with onset at approximately 3 to 6 weeks of age. Causative organisms have not been isolated and the specific environmental conditions conducive to scouring have not been explained. Both the creep rations and the lactation rations have routinely contained terramycin. Incidence is noticeably greater in damp weather.

Scouring may be of variable severity but seldom results in severe dehydration or emaciation and seldom, if ever, results in death losses. In some cases, scouring is persistent, while in others it is sporadic.

Various treatments have been used within the herd. Repeated treatment has been necessary and complete control has not been achieved. This report covers experiments designed to test the effectiveness of various means of preventing or reducing this type of scouring.

Experimental Procedure and Results

Details of the various experiments have varied, but in all experiments control groups have been maintained under the same conditions as the treated groups except for the specific treatments involved. Experiments with each therapeutic agent are reported separately below.

Zinc bacitracin

Eighteen litters farrowed during a 4-week period in August and September 1961, were allotted to four zinc bacitracin treatments. Six of these litters constituted a negative control group in which neither the lactation ration nor the preweaning ration contained any antibiotic. Four litters were given each of the following treatments:

1. No antibiotic in the lactation ration and 100 gm. zinc bacitracin per ton in the preweaning ration.
2. 100 gm. zinc bacitracin per ton of lactation ration and no antibiotic in the preweaning ration.
3. 100 gm. zinc bacitracin per ton of lactation ration and 100 gm. zinc bacitracin per ton of weaning ration.

Each litter was housed in a separate pen having a cement floor with a sleeping area for baby pigs covered by wooden pallets. Pens were cleaned daily and kept freshly bedded. Creep feed was first offered at about 2 weeks of age. Sows were placed on their respective rations immediately after farrowing.

Pigs were ear-notched and individually weighed at birth. Each group was observed daily. When scouring was noted in the pens, pigs were examined individually to determine which ones were scouring.

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Table 1. Number of pig days of scouring as affected by various rations for sows and litters

Treatment[1]	Days of age 1-14	15-28	29-42	43-56	Total	Average incidence/pig
00		3	36	55	94	1.96
01		7	12	6	25	.92
10			7	13	20	.54
11			16	30	46	1.44
Total	0	10	71	104	185	

[1] 00 = no antibiotic in lactation ration or creep ration.
01 = no antibiotic in lactation ration; 100 gm. zinc bacitracin/ton in creep ration.
10 = 100 gm. zinc bacitracin/ton in lactation ration; no antibiotic in creep ration.
11 = 100 gm. zinc bacitracin/ton in lactation ration and creep ration.

Data in Table 1 show well the characteristic pattern of onset and progression of this type of scouring. Of the 185 observed cases of scouring, only 10 occurred during the first month of age. Scouring incidence increased to 71 cases during the next two weeks and then to 104 cases during the period 6 to 8 weeks of age. A significantly greater degree of scouring occurred in the control group and in the group in which both rations contained zinc bacitracin than in the two groups in which only one of the two rations contained the antibiotic.

There was no statistically significant difference in the occurrence of scouring between the group fed the control ration containing no zinc bacitracin and the group fed the rations which contained zinc bacitracin in both the lactation ration and in the preweaning ration. There was no statistically significant difference between the groups receiving zinc bacitracin in either the creep or lactation ration, but these groups differed significantly from the one receiving the antibiotic in both the creep and the lactation ration. In view of these findings, it is difficult to understand the observed lower incidence of scouring in the two treatment groups which did show a statistically significant decrease in incidence of scouring.

Data in Table 2 show somewhat more consistent results than those in Table 1 in the possible beneficial effect of zinc bacitracin on control of this type of scouring. The percentage of pigs which did not scour at all was higher in all cases where zinc bacitracin was used than in the control ration and, further, the percentage of pigs with repeated observations of scouring tends to be less where zinc bacitracin was used.

The total incidence and distribution patterns of scouring are not complete measures of the effect of scouring. It is possible that intensity of scouring may also be an economic factor. If intensity varied, in addition to incidence and distribution of scouring among the various treatment groups, weaning weights might be expected to be lower for treatment groups more severely affected. Table 3 contains average weaning weights for pigs on each ration treatment.

Actual weaning weights are in general agreement with the incidence of scouring, but differences in average weaning weights by treatment groups are not statistically significant.

Table 2. Distribution of scouring incidence in suckling pigs

Number of days scouring observed	Treatment[1] 00 No. pigs	%	01 No. pigs	%	10 No. pigs	%	11 No. pigs	%
0	7	14.6	14	51.9	22	59.5	9	28.2
1	18	37.5	5	18.5	10	27.0	11	34.4
2	10	20.8	5	18.5	5	13.5	5	15.6
3	4	8.3	2	7.4			5	15.6
4	6	12.5	1	3.7			1	3.1
5	0	0.0					1	3.1
6	1	2.1						
7	2	4.2						
Total	48	100.0	27	100.0	37	100.0	32	100.0

[1] See Table 1.

Table 3. Weights at 56 days of pigs as affected by various rations

Treatment[1]	00	01	10	11
56 day weight	30.9	33.2	33.8	29.8

[1] See Table 1.

Blood globulins

Studies by Miller et al., (1961); Lecce and Matrone (1961); Eversole et al., (1961); and Spear et al., (1957) show that blood globulins in the young pig, especially the gamma fraction received from the colostrum, has diminished very markedly by the third to fourth week of age. The pig's ability to produce globulin begins to be significant at about 5 to 6 weeks of age. Thus, a three to four week lag may exist between the depletion of the colostrum-acquired immunity and the onset of development of sufficient gamma globulin to defend pigs against disease agents. In previous seasons much of the scouring occurred during a period corresponding to this "immunity gap," and on this basis it seemed feasible to inject the pig with a supplemental source of antibody protection to reduce effects of this apparent inability of the pig to protect himself against disease agents.

Globulin treatments were administered between the second and third week of age by subcutaneous injection in the axillary region. Four separate treatments were randomized within the 18 litters used in the bacitracin feeding experiments. Each pig received one of the following treatments:

1. Control injected with 5 cc. physiological saline. This is a 0.9% NaCl solution, isotonic with blood, used to subject the control pigs to an injection procedure without any actual treatment.
2. 10 cc. pooled serum from parent herd.
3. 10 cc. gamma globulin (Armour Laboratory).
4. 10 cc. Antrate—hog cholera antibody concentrate (Armour Laboratory).

Two separate analyses of the globulin treatments were made. In one the observations were the weaning weights of individual pigs; in the other the recorded incidence of scouring constitutes the observations. In cases where deaths of pigs on a particular treatment eliminated observations for treatments within litters, no corrections were made for missing observations.

There were no statistically significant differences in average weaning weights by globulin treatment groups (Table 4). The pattern of weaning weight, however, follows quite closely the observed number of incidences of scouring in the different treatment groups. Within litters there was only a low negative correlation between incidence of scouring and weaning weight; the larger pigs scoured as frequently as the smaller ones. There was, however, a correlation of –.454 between average litter weaning weight and the number of occurrences of scouring within litters. This correlation indicates that decreased weaning weights often occurred in litters with a high incidence of scouring.

None of the sources of globulins (Table 5) were fully effective in preventing the occurrence of scouring. There is some indication that the frequency of scouring was lower in those pigs receiving globulins by injection, but the differences were not statistically significant. Most of the pigs were treated at about 2 to 3 weeks old while most of the scouring occurred between the fifth and seventh week of age and especially after the sixth week. Thus, the potential effectiveness of the globulins may have been markedly decreased prior to widespread onset of scouring. Generally, passively acquired globulins are metabolized within 14-21 days after injection.

In the pigs which were injected with serum collected from market hogs of the parent herd there were many instances of abscesses at the site of injection. Performance of the serum injected pigs suggests that these abscesses were not a marked detriment to their growth and health.

nf-180

In accordance with reports by the University of Kentucky (Report of Annual Livestock Field Day, University of Kentucky Agricultural Experiment Station—1959, 1960) of effective control of scours through administering nf-180 in the lactation ration and creep ration and our own effective use of nf-180 suspension in treatment of scours in individual pigs, two experi-

Table 4. Analyses of weaning weights of pigs on globulin treatments

Treatment	Control	Serum	Gamma globulin	Antrate
Means	32.4	32.1	29.8	33.7
No. of pigs	37	42	31	32

Table 5. Average incidence of scouring among pigs injected with various sources of globulins

Treatments	Control	Serum	Gamma globulin	Antrate
Means (average occurrence)	1.43	1.29	1.29	1.09
No. of pigs	37	42	31	32

Table 6. Report of field trial with nf-180 in sow ration as a means of preventing scours in suckling pigs

Litter No.	No. pigs	Birth date	Date and severety of scouring: None	Light	Moderate	Severe	Treatment	Av. 56-day wt.
								lbs.
1	7	2/5			3/1	3/7	nf-180 1st 2 wks	46
2	6	2/12			3/7		nf-180 1st 2 wks	50
3	11	2/16	x				nf-180 1st 4 wks	46
4	13	2/20	x				nf-180 1st 8 wks	52
5	13	2/20	x				nf-180 1st 8 wks	45
6	5	2/22		3/15			nf-180 1st 4 wks	50
7	7	3/1		3/15			no nf-180	32
8	not stated	3/4	x				nf-180 1st 4 wks	46
9	not stated	3/9	x				nf-180 1st 6 wks	57
10	not stated	3/9	x				nf-180 1st 6 wks	57
11	not stated	3/9	x				nf-180 1st 6 wks	57

ments were conducted to test the effectiveness of administering this compound in the feed. One of these was conducted with a producer-cooperator and involved the use of 3 pounds of nf-180 per ton of lactation ration for two, four, six, or eight weeks. No nf-180 was included in the creep ration. Results are shown in Table 6. Records of incidence of scouring refer to the presence of one or more pigs scouring within a litter.

Data in Table 6 are too limited to be conclusive. It can be noted, however, that no scouring occurred in litters in which the sow received nf-180 in her ration for six or more weeks. Of the five cases of scouring observed, four were in litters in which the sow had received nf-180 for two weeks or less.

The second nf-180 experiment was conducted with 11 litters in the Oregon State University herd. The lactation ration for the treated group of sows contained 3 pounds of nf-180 per ton of feed. The pigs were weaned at approximately 30 days of age. Scouring began in the control litters at 23 days of age and in the treated litter at 25 days of age. Frequency of scouring was about equal in each group. Average weight of the control pigs was 17.5 pounds at 28 days of age; average weight of the pigs from the treated litters was 18.5 pounds at 30 days. Both groups of pigs scoured with increasing frequency after weaning. It was concluded that under the conditions of this experiment nf-180 had not controlled the causative agents to a sufficient degree to prevent scouring.

Other therapeutic agents

In the search for corrective treatment on a group rather than on an individual basis we have come to rely on the use of sodium arsanilate in the drinking water at the strength of 2.1 grains of elemental arsenic per gallon of water for six days. We have conducted no experiments with this medicant but our general experience has been a cessation of scours within the treatment period. Occasional retreatment has been necessary.

Most effective treatment of scours can occur when the sensitivity of the causative organism to specific medicants is known. Through the assistance of Dr. K. J. Peterson of the Veterinary Science Department, a type of scouring in newborn pigs within the first 24 hours after birth has been found to be due to a coliform organism highly susceptible to neomycin. In newborn pigs with this type of scouring, complete control within 24 hours after treatment without loss of any pigs has been achieved through use of three drops of neomycin sulphate (200 mg/cc.—Biosol liquid Upjohn).

Conclusions

A late-developing type of scouring with initial onset at about 3 weeks of age has not been effectively eliminated by nf-180 or zinc bacitracin in lactation and creep rations nor by injection of various sources of globulins into pigs at 2 or 3 weeks of age. Each therapeutic agent appeared to have some preventive effect, but did not result in improved weaning weights at the levels used. Sodium arsanilate in the strength of about 2.1 grains of elemental arsenic per gallon of water has been used as a group treatment with beneficial results. Neomycin sulphate has been effective in treatment of a coliform-induced type of scouring in newborn pigs. Most effective treatment of scouring can be practiced when the sensitivity of the causative organism to various medicants is known.

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Some Environmental Factors Related to Survival of Newborn Pigs

DAVID C. ENGLAND and VERNE M. CHAPMAN

It is widely recognized that the number of pigs weaned per litter is of major importance for insuring a profit from swine production. An Indiana study (Ind. Agr. Expt. Sta. Bull. 669) has shown total production costs per hundred weight of hogs produced to be $17.73, $16.64, and $15.35 for herds in which the average number of pigs weaned was 5.9, 7.1, and 8.0 respectively. This same study showed a preweaning death loss of 18% of the pigs farrowed. Thus, approximately one-fifth of the potential income was lost prior to weaning, and the cost of producing these pigs must be paid from income derived from the sale of surviving pigs. Overhead cost per pig at weaning (no direct expenses for the pigs involved) is directly proportional to the number of pigs weaned and has been calculated to be:

No. pigs per litter	Cost per pig
12	$4.06
11	4.43
10	4.88
9	5.42
8	6.09
7	6.96
6	8.12

These costs per pig are based on operational costs of 6 pounds of feed per sow per day for a 115 day gestation period and 10 pounds per day for a 56 day lactation period. Feed cost is figured at $60 per ton. All other costs, including boar cost, labor, etc. have been figured as 30% of the sow cost. Costs are thus $37.50 per litter for sow feed from breeding to weaning and $11.25 for other costs for a total of $48.75 per litter exclusive of direct pig costs such as creep feed, vaccinations, anemia prevention, etc.

It is also widely recognized that the major share of preweaning death losses occur within the first week. A British study (Pomeroy, R. W. Infertility and neonatal mortality in the sow. III. Neonatal mortality and feotal development. Jour. Agric. Sci. *54*:31-56. 1960.) has shown that 80% of death losses occur in the first three days after farrow. Prominent environmental causes of these death losses are crushing, chilling, starvation, and scouring. The vigor of the newborn pig is closely related to susceptibility to each of these factors. An Illinois study has shown only 28% survival for pigs that are weak at birth whereas 82% of the strong pigs survived. Survival rate for the medium-strong pigs was 67% (*Swine Production,* 3d ed., p. 137, W. E. Carroll, J. E. Krider, F. N. Andrews. McGraw-Hill, New York, N.Y. 1962). Inasmuch as the weaker pigs were capable of living in the uterine environment of the sow, it is apparent that the death loss of weaker pigs is due to inability to live in the postweaning environment rather than a complete lack of ability to survive.

It is common knowledge among producers and has been shown by an Indiana study (Ind. Agr. Expt. Sta. Bull. 413) and a recent study of the Oregon Agricultural Experiment Station swine herd (V. M. Chapman, M.S. Thesis)

Table 1. The effect of birth weight on post-natal survival and weaning weight

Birth weight	Number born	Percent of population	Percent survival	Average weaning weight
lbs.				*lbs.*
.... - 1.9	167	8.0	32.3	27.8
2.0 - 2.4	360	17.2	62.7	31.9
2.5 - 2.9	575	27.6	71.1	35.0
3.0 - 3.4	588	28.2	75.0	37.3
3.5 - 3.9	300	14.4	74.3	37.2
4.0 -	92	4.4	82.6	39.8
Total	2,082	100	Av. 68.5	35.56

that birth weight is closely associated with vigor at birth. In the study of 7,554 pigs by Vestal, pigs weighing less than 2 pounds at birth had preweaning death losses of 62.4% as compared to 23.4% for pigs weighing more than 2 pounds at birth. Findings were similar in the study by Chapman. This close agreement indicates no particular change in the past 25 years. It thus appears that the environment commonly provided for newborn pigs is relatively much more adequate for heavier pigs than for lighter ones.

Common environmental causes of death of baby pigs are crushing, scouring, chilling, and starvation. Attention at farrowing or use of farrowing crates eliminates most of the crushing at farrowing. Properly constructed guard rails and protected areas with heat lamps eliminate most later crushing. Scouring may be due to many causes but does not seem to affect pigs of low birth weight more readily than pigs of heavier birth weight. Chilling and starvation are left then as two environmental factors to which pigs of low birth weight may be more susceptible than pigs of heavier birth weight. Studies with the OSU swine herd provide information on these two traits. Death losses according to various birthweights for the period 1953 to 1960 inclusive under routine practices are shown in Table 1.

From the 1961 spring-farrowing litters, a group of 90 pigs were caught in plastic bags at birth and removed immediately to laboratory quarters in which room temperature was kept above 70° F. In addition heat lamps provided supplemental heat over the areas in which the pigs were kept. The closed room had controlled ventilation and was free of drafts. The pigs were

Table 2. Average milk intake per feeding for artifically reared baby pigs

Birth weight	Pigs	Average milk intake
lbs.	*no.*	*ml.*
1.2	6	29.1
1.4	3	37.1
1.5	4	36.6
1.6	1	41.6
1.8	5	48.7
1.9	3	52.0
2.0	5	52.6
2.1	2	54.6
2.2	3	49.7
2.3	4	51.3
2.4	9	55.2
2.5	9	61.5
2.6	5	55.0
2.7	4	61.8
2.8	7	62.7
2.9	4	62.5
3.0	7	67.2
3.1	2	70.8
3.2	6	70.0

individually fed by bottle and nipple during the first five days. Only one pig died. The distribution of birth weight and milk intake are shown in Table 2.

It can be seen from data in Table 2 that pigs of low birth weight consume less milk than heavier pigs under conditions free from competition. It was also strongly apparent that pigs of low birth weight nursed less rapidly and with less force than heavier pigs. Both of these latter observations and the data in Table 2 indicate that pigs of low birth weight encounter greater risk of starvation than do heavier pigs. This greater risk coupled with the greater proportional heat loss by small pigs would be expected to make pigs of low birth weight more susceptible than heavier pigs to death loss from starvation and chilling.

During summer of 1962, 92 pigs were farrowed. For these pigs, heat lamps in farrowing crates were provided. Scouring was present in many of these pigs within a few hours after birth. Treatment with neomycin sulphate corrected scouring within 24 hours. The herdsman supplementally bottle fed each weak-appearing pig. Such supplemental feeding was practiced for several days where needed. All 92 pigs survived and grew normally.

The above experiment and experiences indicate that provision of adequate temperatures and availability of food may be the primary environmental factors needed to insure improved preweaning survival. It is clear that small pigs have the innate ability to survive under environmental conditions that meet their requirements. It appears that increased awareness of environmental requirements of smaller pigs can lead to better survival rates.

Slatted Floors Over a Water Pit for Swine

David C. England

With large-scale confinement rearing of swine, disposal of manure has become a time-consuming chore for many swine producers. In recent years, two sound management principles that eliminate much of the labor involved have received widespread application. One of these principles is the use of floors so constructed from various materials that hogs trample manure through openings in the floor. With such floors, pen cleaning is no longer necessary, but accumulated manure must be periodically removed from beneath the floor. The second practice is washing manure from cement floors into drain tiles that carry it into lagoons where it decomposes under water.

Primary advantage of the latter system is the time and labor saved in cleaning cement floors and disposal of manure onto fields. For the former there is the additional advantage of improved sanitation from pens that are always clean without labor spent for cleaning. There also is increased efficiency of the herdsmanship. There is no need to neglect an important chore such as attention to a farrowing sow, mixing of feed, filling feeders, or record keeping because pens have to be cleaned. Thus, each of these systems are improved management practices.

It should hold true that if these two principles work satisfactorily separately, they should work satisfactorily together. On the basis of this reasoning, an experimental unit was constructed at OSU in which a slatted floor was established over a water-filled trench 8 feet wide, 5 feet deep, and 24 feet long. One-half of this area was covered by Douglas fir "slats" made by ripping two by sixes diagonally. Such slats were 2 inches thick and about 4 inches wide on one surface and about 2 inches wide on the other surface. The slatted floor was constructed by nailing these slats in place with the wide surface up on 2 x 12 cross supports placed 24" apart center to center. Spacing of the slats was ⅝" at the top or "floor" surface and consequently about 2⅝" apart at the underneath surface. The open space between each pair of slats was thus composed of a gradually widening area with one straight side and one beveled side. Figure 1 shows details of the slatted floor structure.

The other half of the water-filled pit was covered with nine guage flattened expanded metal with diagonal openings of ⅝" x 1¼". It was necessary to provide cross supports at 12 inch-intervals for this type of slatted flooring.

Initial use of these floors was from June to October and compared the growth rate of market hogs on the two types of self-cleaning floors with a comparable group of pigs on cement floor. The 10 pigs per pen on slatted floors over the water area had 9.6 square feet per pig, including a self feeder and a 50 gallon water barrel. The 10 pigs on cement had 15 square feet of area per pig. Average daily gains are shown in Table 1.

The second experiment was conducted during the winter and compared the growth rate of weaned pigs on slatted floors with that of pigs on cement floors. The four pens of eight pigs each on the slatted floors had 6 square feet of space per pig, including a feeder and waterer in each 48 square-foot area. Pigs on cement floor had 16 square feet per pig. Average daily gains of these pigs are also shown in Table 1.

Average daily gains of all pigs were undesirably low due to temporary but now corrected production problems. Lowered gains were not related to the type of floors used. Average gains on the two types of slatted floors were equal to gains with similar pigs on conventional cement floors.

It was not necessary at any time to clean either type of slatted floor during the period required from weaning to market for two successive groups of pigs. These pens and the pigs in them remained cleaner than pigs and cement floors of pens cleaned daily. Objectionable odors were no more prevalent from the water-covered manure in the pit than from cement floors cleaned daily.

After two groups of pigs had used

Table 1. Average daily gains of market hogs kept on various kinds of floors

Kind of floor	Average daily gain	
	Experiment 1	Experiment 2
	lbs.	*lbs.*
Wood slats over water pit	1.37	1.23
Flattened expanded metal over water pit	1.24	1.24
Cement floor	1.39	1.25

slatted floors from weaning to market, accumulated manure was pumped from the pit by use of a 3-inch diaphragm pump. A water hose running at the intake pipe resulted in consistency of manure that permitted steady pumping. Five hours of pumping emptied the pit. Odors associated with accumulated manure were far less pronounced than those resulting from manure stored in the usual fashion and were not noticeable as close as 100 feet away.

After one year of use, the flooring material is in good condition. Producer experience indicates the wisdom of using good quality lumber if wood slats rather than expanded metal are used. Broken slats can be easily replaced.

The only disadvantage noted to date for slatted floors above a water pit is less ready detection of feed wastage. Careful attention to feeders and a slight area of solid floor in front of feeders—perhaps 12 inches wide—to permit easier observation of feed wastage appear to eliminate undetected feed wastage.

Sows and suckling pigs utilize slatted floors with the same apparent success as market hogs. Not a single instance has been noted of baby pigs with feet caught in the openings. The usual requirements of warmth, freedom from drafts, and a protected area for baby pigs must be provided. A thin plywood covering of the floor in the suckling pig area does not reduce self-cleaning and may be helpful in meeting requirements of baby pigs.

Self-cleaning properties of the floor are fully maintained for individual pigs kept in pens 2 feet x 4 feet. Experiments are in progress to determine the effects of such close confinement on growth rate and feed efficiency and physical condition of the pigs. If adverse effects do not occur, the major obstacle of tedious pen cleaning for individual pigs will be removed and in-

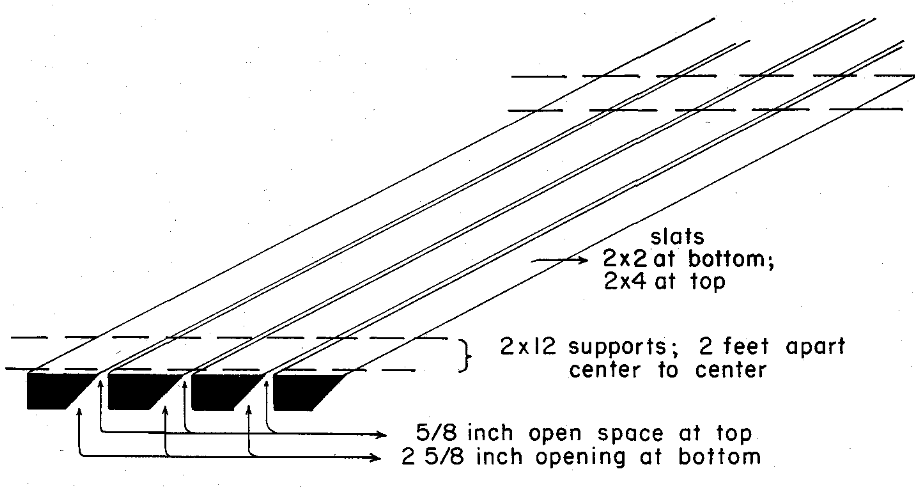

FIGURE 1. Structure of slatted floor.

dividual feeding of pigs for performance test, nutritional or other experimental purposes, or as a production practice will be greatly enhanced.

The principle of slatted floors above a water pit for temporary storage of manure appears to be adaptable to all phases of swine rearing requiring the confinement of swine. The water pit with 6 square feet of surface area per pig is not a lagoon in the sense of providing a permanent storage and breakdown of manure. It appears rather that self-cleaning with temporary storage that eliminates odors and flies and provides for further self-disposal of manure into a permanent lagoon at the operator's convenience is the proper function of slatted floors above a water pit.

Postweaning Gains and Farrowing Performance of Swine Reared in Isolation

David C. England

A system artificially rearing pigs from birth in complete isolation from other swine was described at the Third Annual Swine Day (Oregon Agricultural Experiment Station Misc. Paper 117, 1961). Survival rates and weaning weights were reported but postweaning tests were not completed at that time. The 113 animals involved have now proceeded through postweaning test, selection of replacement males and females, and farrowing of litters.

Performance from birth to 154 days of age for five different groups of isolation-reared pigs is shown in Table 1. Causes of the relatively high death loss in groups 2 and 3—though these are well within the limits of usual swine production results—were given in the original report referred to above.

Variation in postweaning growth rate of pigs within litters and groups was similar to that normally exhibited under usual swine production conditions. Individual 154-day weights ranged from 152 to 243 pounds for group 1, from 133 to 236 pounds for group 2, from 87 to 217 pounds in group 3, from 134 to 188 pounds in group 4, and from 176 to 246 pounds for group 5. The 12 pigs in group 5 were composed of a single litter.

While the spring-farrowed pigs that were caught in plastic bags were being reared in isolation, their dams were rebred for fall farrow. After the fall-farrowed litters were weaned, the sows were sold for slaughter. Breeding of the females reared in isolation was delayed until the fall-farrowed pigs were

Table 1. Survival and growth performance of artifically reared pigs

Group	Pigs kept	Survival to 56 days		Average 56-day wt.	Average 154-day wt.	Average daily gains, 56-154 days
		no.	*%*	*lbs.*	*lbs.*	*lbs.*
1	25	22	88.0	29.2	191	1.65
2	30	29	96.7	30.4	195	1.68
3	63	33	52.4	21.8	162	1.43
4	33	17	51.5	19.0	162	1.46
5	13	12	92.3	27.6	200	1.76

3 months old to insure a full month break in the central swine unit between disposal of the parent herd and farrowing of litters by the females reared in the isolation herd.

Immediately after sale of the last market hogs from the fall-farrowed litters, all floors, walls, and equipment of every kind were thoroughly scrubbed and steam cleaned. The isolation-reared females were then brought into the central swine unit a few days before expected farrowing. Farrowing results are given in Table 2.

It can be seen from Table 2 that farrowing performance for both live and dead pigs for gilts reared and maintained in isolation follows the usual pattern found in herds maintained in the conventional manner.

It is to be expected that postweaning growth and farrowing performance of pigs reared in isolation as practiced *with this* herd will fit the pattern exhibited by swine under usual production conditions, since usual husbandry practices were followed. It should be remembered however, that these animals were carefully protected from contact with other swine or contact with persons or objects that were in contact with other swine.

Table 2. Number of pigs born per litter to gilts reared in isolation

Berkshire			Yorkshire		
Gilt no.	Alive	Born dead	Gilt no.	Alive	Born dead
1	13	0	1	9	1
2	7	0	2	9	3
3	10	0	3	10	1
4	11	0	4	9	0
5	8	0	5	9	0
6	5	0	6	11	0
7	8	0	7	9	0
8	11	0	8	8	0
9	10	0	9	0	6
10	9	0	10	8	0
11	8	0	11	11	0
12	8	0	12	12	0
13	6	0	13	7	0
14	9	0	14	8	0
15	7	0	15	11	0
16	9	0	16	10	0
17	9	3	17	7	0
18	10	1	18	8	0
19	6	1	19	11	0
Total	164	5		167	10
Average	8.6	0.26		8.8	0.53

Reproductive Performance of Yorkshire and Berkshire Females

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Number of pigs born alive per litter is determined by the level and interaction of three separate biological processes: 1) number of eggs ovulated; 2) number of eggs fertilized; and 3) extent of embryonic death during gestation. Number of pigs born alive can vary due to a change in any one or more of these three component parts. Research has shown, however, that fertilization occurs for at least 95% of the eggs when a normally fertile boar is used. Thus, major differences in litter size between breeds and between females within a breed are due to differences in ovulation rate or to embryonic deaths.

Yorkshire and Berkshire females have farrowed in the OSU swine herd during three seasons. Average number of pigs born alive for each group during each season is shown in Table 1.

A distinct breed difference in number of pigs born alive is indicated by data in Table 1. Since all animals had the same management and nutritional background, these differences can be attributed to hereditary causes. Data in Table 1 do not, however, indicate whether differences are due to differences in ovulation rate, in embryo mortality, or in both. To obtain information on causes of observed differences in average litter size, sows were slaughtered approximately three weeks after breeding. Counts were made of eggs ovulated and number of live embryos. These data are shown in Table 2 on page 30.

From data in Table 2 it can be seen that: 1) the genetic group (Yorkshire breed) that had the highest ovulation rate also had the largest average number of live embryos and had previously farrowed the largest average litters; 2) both on a within and a between breed basis, high ovulation rate and high embryonic survival can, but do not necessarily, exist together. It thus appears that selection for large litter size will tend to emphasize both high ovulation rate and high embryonic survival. It further appears that management practices that increase ovulation rates should result in increased litter size, since there does not appear to be any antagonism between high ovulation rate and high embryonic survival.

Table 1. Number of pigs born alive per litter

	Berkshires	Yorkshires
Pigs born alive/litter—spring 1961	7.6 (14)*	11.0 (9)
Pigs born alive/litter—fall 1961	7.9 (16)	12.2 (10)
Pigs born alive/litter—spring 1962	8.9 (10)	9.2 (16)

* Figures in parentheses refer to number of litters on which average is based. Spring 1962 litters were from gilts.

Table 2. Litter size, corpora lutea, and viable embryos of sows slaughtered three weeks after mating

Sow no.	Av. litter size in prior litters	No. corpora lutea	No. embryos[1]
	lbs.		
Berkshire			
65-6	7.0	11	Not bred
58-104	10.0	15	Not bred
58-11	8.8	18	Not bred
65-5	10.0	18	10
21-6	7.0	16	12
57-186	7.9	18	8
58-51	7.8	15	6
58-68	8.5	14	13
60-4	5.5	13	8
68-5	8.0	13	12
67-6	8.5	10	9
58-78	8.0	17	11
69-5	5.5	16	12
65-7	4.0	15	11
15-6	8.5	13	5
67-4	8.5	11	8
Av.	7.7	14.6	9.6
Yorkshire			
54-11	13.0	19	Not bred
57-11	9.5	17	0
57-7	13.0	19	17
55-6	10.0	21	14
54-10	12.0	18	12
57-10	9.5	18	10
54-7	9.5	18	16
55-8	9.5	21	0
55-9	13.0	25	23
57-9	9.0	12	0
55-4	8.5	23	21
Av.	10.6	19.2	15.9

[1] Sows without embryos not included in averages.

Postweaning Growth of Light and Heavy Pigs Within Litters at Weaning

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Weaning weight of pigs varies considerably within most litters. These differences may be due in part to heredity, to udder section nursed, to different degrees of scouring, or other specific or nonspecific disease conditions, to weight at birth, or to other influences that affect individual pigs differently. To the extent that differences in weaning weight are due to heredity or to environmental influences that have a continuing effect on the pigs involved, differences at weaning will be reflected and perhaps increased in the postweaning period. To the extent, however, that differences are due to temporary environmental influences that have not permanently handicapped lighter pigs at weaning, they may be expected to gain as rapidly as heavier pigs from any given starting weight to market weight. Lighter pigs at weaning will, of course, be older at any given weight than will pigs that are heavier at weaning.

To determine comparative growth rates of heavy and light pigs within litters, 40 littermate pairs of pigs from the fall of 1961 farrow were placed on postweaning experiments under such conditions that heavier and lighter pigs could be compared directly for growth rate. Each littermate pair of pigs consisted of a heavy and a light pig at weaning. Pigs were in pen groups of four heavy and four light pigs per pen. Average growth rates for each pen of four heavy and four light pigs is shown in Table 1.

In every pen except one, the four pigs that were heavier at weaning gained more rapidly than did the four

Table 1. Initial weights and average daily gains of heavy and light littermate weanling pigs

	Heavy		Light	
Pen no.	Initial weight	Av. daily gain	Initial weight	Av. daily gain
	lbs.	*lbs.*	*lbs.*	*lbs.*
1	38	1.34	31	1.16
2	42	1.29	29	1.13
3	44	1.25	32	1.08
4	43	1.44	32	1.18
5	44	1.31	32	1.23
6	45	1.27	30	1.05
7	46	1.18	32	1.12
8	49	1.19	32	1.16
9	38	1.29	28	1.35
10	37	1.39	29	1.27
Average	43	1.30	31	1.17

lighter ones. Differences in average daily gain were statistically significant. It is thus concluded that under the conditions influencing weaning weight and postweaning gain in these experiments, heavier pigs at weaning gain more rapidly from weaning to market than do lighter ones.

It is generally recognized, however, that size itself has a relationship to growth rate of pigs. To determine whether lighter pigs at weaning grew at the same rate as their heavier-weaning littermates during the same weight periods, average daily gains of each group were determined from a starting weight of 50 pounds to an end weight of 100 pounds. During this weight-to-weight period, growth rate of each group was 1.32 pounds per day. It thus appears that starting weight alone has a strong influence on comparative growth rates of pigs of different sizes. Primary differences in time required to reach market weight is therefore due to added time required by lighter pigs to reach weights at which heavier pigs were weaned. In these experiments, lighter pigs were 23 days older at 50 pounds weight than were heavier pigs.

The above relationships suggest that husbandry practices that meet requirements of larger pigs within litters may not be adequate for smaller ones. Weight rather than age may well be the safest guide to husbandry practices that will result in the best performance of which the pig is capable.

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