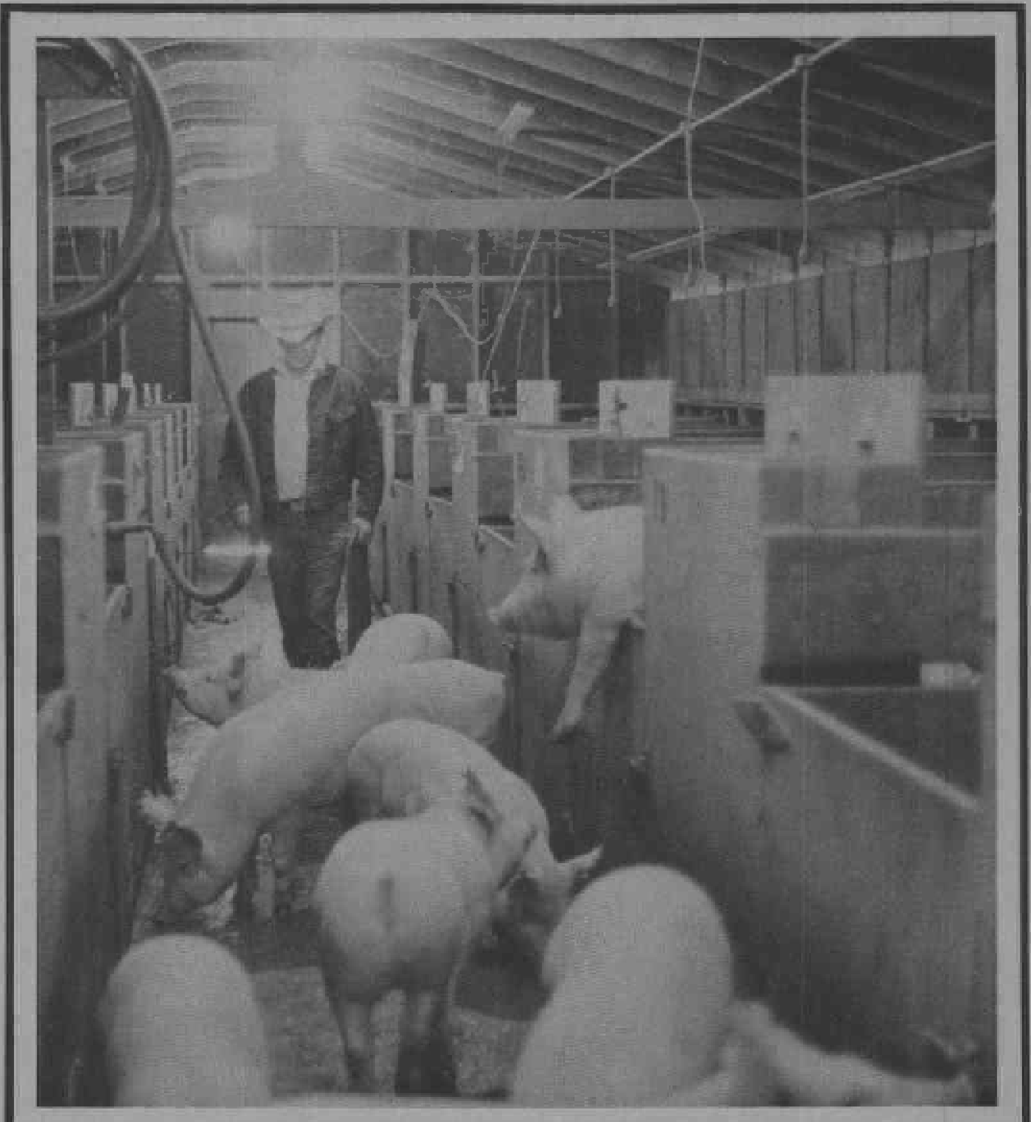
Reports of the

23rd Annual Swine Day



Special Report 643
December 1981
Agricultural Experiment Station
Oregon State University, Corvallis

PROGRAM

OREGON STATE UNIVERSITY SWINE DAY

Withycombe Auditorium
Saturday, December 5, 1981

MORNING PROGRAM: Presiding - Raymond Kaser

9:30 Welcome - James E. Oldfield

9:50 Reproduction by Gilts in Confinement - David C. England

10:30 A Programmable Calculator in Your Swine Production Future? - W. Allen Nipper

10:45 BREAK

11:00 Handling the Nutritional Problems of Weanling Pigs - Donald C. Mahan

12:00 LUNCH

Roast Market Hog: Prepared and served by members of the Withycombe Club and the Clark Meat Science Laboratory

12:45 Presentation of Moorman Pork Production Scholarship Award - Lee K. Rozelle

AFTERNOON PROGRAM: Presiding - Gene Pirelli

1:00 Report from the Oregon Pork Producers Association - Louis Hesse

1:20 Report from the Oregon Porkettes - Kay Stinson

1:40 Performance of Barrows Fed a Wheat Finisher Ration with Differing Protein Supplementation - David C. England

2:00 Litter Production by Gilts of Different Weights - Calvin Walker

2:35 BREAK

2:45 Production Response by Swine to Diets with High Alfalfa Content - Paul Bellatty

3:20 Audience Participation - Questions and Answers Session

3:40 ADJOURN

WHO'S WHO IN THE DAY'S EVENTS

Bellatty, Paul E. - Graduate Research Assistant, Department of Animal Science, Oregon State University, Corvallis

England, David C. - Professor, Department of Animal Science, Oregon State University, Corvallis

Hesse, Louis - President, Oregon Pork Producers Association, Beaverton, Oregon

Kaser, Raymond - President-Elect, Oregon Pork Producers Association, Molalla, Oregon

Mahan, Donald C. Professor, Department of Animal Science, Ohio Agricultural Research & Development Center, Ohio State University, Wooster, Ohio

Nipper, W. Allen - Assistant Professor, Department of Animal Science, Oregon State University, Corvallis

Oldfield, James E. - Professor and Head, Department of Animal Science, Oregon State University, Corvallis

Pirelli, Gene - Polk County Agent, Extension Service, Dallas, Oregon

Rozelle, Lee J. - Director-Public Relations, Moorman Mfg. Co. of California, Inc. San Gabriel, California

Stinson, Kay - President, Oregon Porkettes, Hillsboro, Oregon

Walker, Calvin - Graduate Research Assistant, Department of Animal Science, Oregon State University, Corvallis

ACKNOWLEDGMENTS

The staff of permanent herdsmen and part time student employees at the Swine Center contribute to the accomplishments of all production research through their specific and general care and management activities. Current herdsmen at the Swine Center are: Roy Fancher, Greg Hoffman, Mark Uhden. Dr. Walter H. Kennick and Robert Dickson contribute to all carcass research through their general and specific activities at the OSU Clark Meat Science Laboratory. Current graduate students conducting thesis research with swine are Anthony Archibong, Paul Bellatty, Stewart Floyd, Sommai Tachasirinugune, Calvin Walker. Current resident undergraduate student employees at the Swine Center are Lucy Krakowiak and Linda Markin.

The Withycombe Club, with the assistance of the Clark Meat Science Laboratory personnel, prepares and serves the roast market hog lunch.

CONTENTS

A PROGRAMMABLE CALCULATOR IN YOUR SWINE PRODUCTION FUTURE?

W. A. Nipper
Department of Animal Science
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In recent years, advancements in electronic technology have resulted in the development of hand held programmable calculators that can be purchased at a reasonable price. These programmable calculators have the potential to become a useful management tool for anyone involved in agriculture. Basic mathematical operations such as addition, subtraction, multiplication, and division can be performed along with special operations such as squares, square roots, means, standard deviations, etc. However, the special feature of these calculators is the ability to store and recall data, and then to use these data automatically in a mathematical computation that requires numerous steps for completion. If the computation was performed manually, a large number of entries from the keyboard would be required. With the use of a pre-written program only a few entries are required. For example, a program that has been developed to formulate rations using five feeds and five nutrients requires the use of only 20 keys on the calculator keyboard. Manual computation to obtain the same answers would require approximately 200 entries from the keyboard.

Therefore, the programmable feature of these calculators can save a great deal of time especially when calculations are used repeatedly. Developing a program for one of these calculators does not require an extensive knowledge of programming; all one needs to know is the mathematical computations required to solve the problem and the particular calculator's format for accepting information. Developing a program and entering the program into the calculator can be time consuming. Therefore, programs are normally only developed for lengthy computations that are expected to be used repeatedly. Once a program is developed, entered into the calculator, and tested for accuracy, the program should be saved for future use. Saving the program can be accomplished in several ways. The individual steps could be written out and reentered into the calculator each time; however, this is a lengthy process. Some calculators have a constant memory feature that will retain the program even when the calculator is turned off, but only that one program could be used. More permanent storage is available in the form of a magnetic card on which a program can be stored. To use the program again, one only needs to "read" the program back into the calculator by inserting the card through the calculator's card reader. Another form of permanent storage is the module (chip) on which many programs can be stored. These modules connect electronically with the calculator and provide easy accessibility to any of the programs stored within. Pre-programmed modules would normally be available from the manufacturer.

Programs are available in many subject areas. Programs directly related to agriculture are not as numerous as programs related to other areas such as engineering. Lack of programs currently limits the use of programmable calculators in agricultural operations. In the area of animal production, several universities have developed programs that can be helpful. A few of the program titles are listed in Table 1. Individual programs that were developed by a university can normally be obtained at a minimal cost, and some new programs are now being developed and sold commercially. Most programs can be provided by listing of the individual steps or on a magnetic card. However, one calculator manufacturer has a module that is devoted specifically to agriculture, and this module contains several programs that are related to animal production.

TABLE 1. PARTIAL LISTING OF PROGRAMS THAT RELATE TO ANIMAL PRODUCTION THAT ARE AVAILABLE FOR USE WITH A PROGRAMMABLE CALCULATOR

Batch Size Calculations For Complete Feeds
Cattle, Pig, or Lamb Feeding Economic Analysis
Complete Feed Formulation and Ration Evaluation
Dairy Ration Analyzer
Dairy Ration Balancer
Forage Energy Predictor
Least-cost Ration Formulation
Net Energy For Feedlot Cattle
Production Analysis of Cow-Calf, Ewe-Lamb, Farrow-Finish Hog Operations
Ration Analyzer for Beef Cows
Ration Analyzer for Feedlot Cattle
Ration Cost Calculator
Ration Formulation
Swine Ration Analyzer

Different brands of calculators may use a slightly different mathematical language or approach to problem solving. Therefore, programs developed for one calculator may not be directly convertible to use with another brand. Many of the original programs that were developed for one calculator are being converted currently into other languages. However, not all programs are currently available in all languages, and the usefulness of a calculator may be limited until all the conversions are completed. Therefore, until programs in agriculture and animal production become more universal, it would be wise to consider the availability of programs for a particular calculator before purchasing it.

Programs that were developed in one region of the country may not be totally utilizable in another region. However, with a little programming skill, one can take any program, whether in a written, card, or module format, and modify the program to a particular need. Normally the problem encountered is the magnitude by which to modify values in existing programs rather than the programming format.

A problem with programmable calculators is that their storage and computation capacity is limited. Therefore, one cannot expect to solve large mathematical problems, such as a least-cost ration formulation, in the same manner as done with a computer. Also, the calculator cannot be expected to provide storage and retrieval of information such as animal inventory and performance records. Printer capabilities are available, but these are limited when compared to computer printouts. Certain calculators also have an additional alpha feature which provides a letter display directly from the calculator's display. This capability is most useful as a prompter for information needed to proceed through the program.

Examples of two programs are provided in Tables 2 and 3. Table 2 contains an example of a module program that will formulate a ration using from 2 to 5 feedstuffs. This example is for a swine ration in which barley, soybean meal, dehydrated alfalfa, oats and tankage were the feeds available. The program requires that the last three feedstuffs (dehydrated alfalfa, oats, tankage) be included at a fixed percentage. Feedstuffs number one and two (barley and soybean meal) will be balanced to meet the requirements specified when the amounts of the other three feeds are considered. Before running the program, one must store the nutritive value of the feeds in the calculator manually or from data stored on a magnetic card. In this program the nutrient values must be entered in the same order for each feed, and the nutrient that is to be balanced must be in either the number one or two position. The percentage of feeds 3, 4, and 5 is entered followed by the percentage of the nutrient desired, i.e. percent crude protein. Pressing the "R/S" key will then provide a printout of the percentage of all feeds needed in order from number one through five and a composition of the mix.

TABLE 2. EXAMPLE OF RATION FORMULATION PROGRAM

Step	Enter	Description	Press	Display	Print out
1	2nd Pgm 09	Calls program	--	0	---
2	2nd E'	from module	--	639.390	---
3	---	Begins program	C	3.000	---
4	10	% feed 3 required	R/S	4.000	---
5	5	% feed 4 required	R/S	5.000	---
6	2	% feed 5 required	R/S	0.000	---
7	14	% CP desired	A		
8	---	% feed 1 used	--	75.679	75.679
9	---	% feed 2 used	R/S	7.321	7.32
10	---	% feed 3 used	R/S	---	10.00
11	---	% feed 4 used	--	---	5.00
12	---	% feed 5 used	--	---	2.00
13	---	% CP required	--	14.00	14.00
14	---	% Ca in mix	R/S	0.316	.316
15	---	% P in mix	R/S	0.194	.194
16	---	Kcal DE in mix	R/S	2742.348	2742.34
17	---	$/cwt mix	R/S	6.344	6.34

The ration as formulated would not be a least-cost formulation. However, by repeating the program and changing the percentage of feed 3, 4, and 5, it may be possible to formulate another acceptable ration but at a lower cost. For example, the cost of the ration can be reduced to $6.21/cwt by using 15%, 10%, and 2% of feeds 3, 4, and 5, respectively, without significantly altering the Ca, P, or DE values.

The example in Table 3 is from a module program that provides a production analysis of a farrow to finish hog operation. A similar program could be used for an analysis of a feeder pig operation. The first 24 steps enter into the calculator different production and cost parameters that are unique to the operation being analyzed. These 24 inputs can be accomplished manually from the key board each time or they can be stored on a magnetic tape for subsequent use. An advantage of storing these inputs on a magnetic card is that these data can be entered quickly and then any value can be updated as needed.

Once the inputs are entered, the "A" key on the calculator is pressed, and the necessary selling price of the market hog to cover total feed and other variable costs is displayed. Pressing the other keys indicated in Table 3 will result in a display of the appropriate prices and weights as listed.

This program could be of use to a hog producer when he is making his decision whether to sell feeder pigs or finish out the pigs in his operation. It also can be used to decide if it would be economical to market the hogs at a different weight or to change other production variables. However, changes made in one variable may change another variable, and one must consider if the second variable should be altered. For example, if one keeps hogs to a heavier market weight, the feed inputs must be adjusted upward before any output can be determined.

The hand held programmable calculator can be a useful tool for the livestock producer, Extension agent, or feed salesperson. Because of their limited capacity, they cannot be expected to compete with a large computer. However, their use can help the operator make rapid day-to-day decisions without having to conduct time-consuming mathematical operations on a non-programmable calculator. Their portability also helps to extend the capability of the operator from his office out into the field or barn.

TABLE 3. EXAMPLE OF A PRODUCTION ANALYSIS PROGRAM FOR A FARROW-TO-FINISH OPERATION

Step	Enter	Description	Press	Display
1	.12	Annual interest per cycle, %/100	STO 1	.12
2	80	Labor cost/litter, $	STO 2	80
3	60	Vet, operating, miscellaneous cost/litter, $	STO 3	60
4	10	Marketing cost/litter, $	STO 4	10
5	250	Breeding stock investment/litter, $	STO 5	250
6	1.88	Boar deprec./sow/litter, $	STO 6	1.88
7	95	Deprec., int., tax, ins. on bldg. and equi./hd, $	STO 7	95
8	.01	Death rate of sows, %/100	STO 8	.01
9	.5	Sow replacement rate, %/100	STO 9	.5
10	4	Cull sow wt, cwt	STO 10	4
11	7.5	Market hogs/litter, hd	STO 11	7.5
12	2.2	Market hog wt, cwt	STO 12	2.2
13	40	Est. cull sow price/cwt, $	STO 13	40
14	45	Est. market hog price/cwt, $	STO 14	45
15	5725	Feed 1 (corn) wt, lb	STO 15	5725
16	.07	Price/lb, $	STO 16	.07
17	992	Feed 2 (SBM) wt, lb	STO 17	992
18	.125	Price/lb, $	STO 18	.125
19	80	Feed 3 (starter) wt, lb	STO 19	80
20	.1	Price/lb, $	STO 20	.1
21	275	Feed 4 (grower) wt, lb	STO 21	275
22	.09	Price/lb, $	STO 22	.09
23	0	Feed 5 wt, lb	STO 23	0
24	0	Price/lb, $	STO 24	0
25	---	Calls program from module	2nd Pgm 14	---
26	---	Necessary selling price to cover total feed and other variable cost/cwt, $	A	43.26
27	---	Necessary selling price to cover total cost/litter, $	B	51.50
28	---	Profit and return to management/ litter, $	C	-100.03
29	---	Returns to labor and capital/ litter, $	D	147.05
30	8	Necessary selling price to cover total cost/litter with alternate no. of hogs, $	E	48.06
31	2.5	Necessary selling price to cover total cost/litter with alternate hog wt, $	2nd E'	45.32

HANDLING THE NUTRITIONAL PROBLEMS OF WEANLING PIGS

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Ohio State University (Wooster, Ohio)

Swine producers could dramatically improve the productivity (and potential income of their herd operation) if they could wean pigs earlier and rebreed the sows promptly. The work of Hays et al. (1978) at Kentucky demonstrates that if sows could be weaned at 18 days post-farrowing the subsequent conception rate, number of live pigs born and the number of pigs produced annually would be optimized. Consequently, efforts should be made to wean sows so these reproductive potentials can be achieved.

Probably the largest stumbling block involves the success of the weaning program. Often the problems encountered by early weaning cause producers to revert to weaning at later, "more successful" periods.

The criteria necessary to successfully wean pigs between 2 to 5 weeks of age can be closely identified and their relative importance established. We probably could categorize the major problem areas of early pig rearing as environment, nutrition and disease. The relative position of these are probably in the order presented, but all three must be seriously addressed if the program is to be successful. For example, if environmental and nutritional factors are understood and well controlled, the problem with disease will be greatly minimized.

The advent of flat-deck pens, all-in all-out weaning programs, environmentally controlled nurseries and a more complete nutritional knowledge of young swine have resulted in a greater appreciation by both scientists and producers in recognizing several factors necessary for successful weaning programs. Young swine need a "micro"-environment around their living quarters that must be warmed without circulating air either being heavily ladened with dust (i.e., bacteria) or resultingin drafy conditions. Sanitation and dryness of the facilities are of utmost importance. The younger the pig the more critical are these environmental and management conditions. Regardless of the quality of diet offered to weanling swine, these factors must be strongly adhered to or the weaning program is doomed to failure.

One must be aware that the digestive enzyme system of the young pig changes dramatically the first weeks of its life (Figure 1). When the young pig is born it has absolutely no ability to break down the complex nutrients of cereal grains. However, it is capable of utilizing the nutrients in milk (protein, fat, lactose).

These components must initially be broken down to an absorbable form by the action of digestive enzymes produced by the young pig. Once this is accomplished, these nutrients are readily absorbed and utilized. Although young pigs have the ability to digest lactose (milk sugar) from milk, this facility declines with age; a trait which appears to be influenced somewhat by pig breed. Consequently, when the pig loses the ability to effectively digest lactose at an older age, it will scour if fed a diet containing substantial quantities of milk sugar.

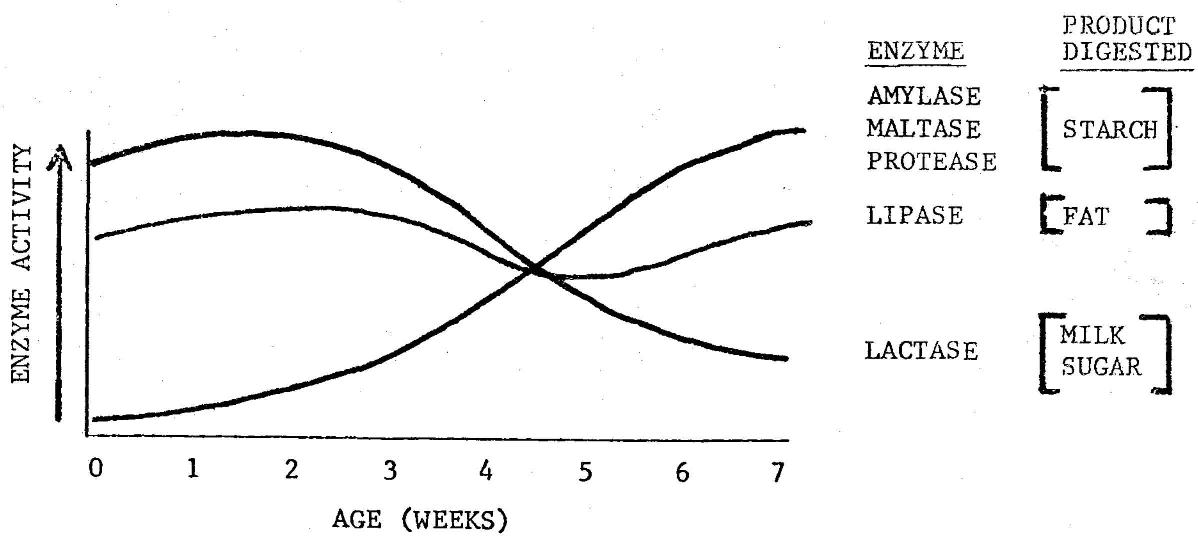

FIGURE 1. SCHEMATIC TRANSITION OF ENZYME DEVELOPMENT PATTERNS IN YOUNG SWINE

The pig's capacity to digest complex carbohydrates and proteins of cereal grains increases slightly during the first few weeks of life. However, the pig cannot digest large quantities until 5 to 7 weeks of age. It would be more desirable to think about both pig age and weaning weight rather than to rely solely on the pig's age to determine when this enzymatic transition occurs since the physiological age of the digestive tract closely corresponds to both factors. The digestive incapacity of the young pig to break down the complex molecules in cereal grains is often the main reason why swine producers experience stunted, poor-doing pigs when they wean directly onto a cereal grain diet.

Consequently, with young pigs from 8 to 12 pounds body weight, we need to consider not only the dietary components they can digest effectively but also ones which are economical.

The use of simplified versus complex diets has generally resulted in better performance being obtained with the more complex formulations. We considered such diets with 8 to 10 pound pigs, evaluating pig performance for a 28-day postweaning period. The effectivenes of a corn-soybean meal-oat diet with the addition of dried whey (DW), dried skim milk (DSM), dried fish solubles (FS) and sugar was evaluated.

The results reported in Table 1 demonstrate that the incorporation of dried whey (or those diets where dried whey was added) resulted in optimum performance, whereas, adding dried skim milk did not. Results not presented here show that if the deit was fed without dried whey, pig performance would be decreased by approximately 35 percent. Consequently, such a product is needed with pigs of this weight.

TABLE 1. EFFECT OF SINGLE OR MULTIPLE INGREDIENT ADDITION TO WEANLING PIG DIETS

	Corn-soybean meal-oat diet plus				
Item[a]	DW(25%)	DSM(15%)	DW(12.5%) DSM(7.5%) Sugar (5%)	DW(12.5%) DSM(3.5%) Sugar (5%) FS (4%)	SE
Daily gain	.42	.35	.44	.44	.01
Daily feed	.71	.60	.71	.71	.02

[a]Average initial weight of pigs was 8.8 pounds with each treatment mean representing 107 pigs.

Graham _et al_., Journal of Animal Science 53:299 (1981).

A second experiment evaluated the levels of dried whey (15 to 35 percent) which would result in maximum postweaning performance. The results presented in Table 2 demonstrate a linear improvement in growth rate and feed intake when weanling pigs were fed levels to 35 percent, demonstrating the responsiveness of young swine to such diets.

TABLE 2. EFFECT OF FEEDING VARIOUS DRIED WHEY LEVELS WITH WEANLING PIGS

	Dietary dried whey level (percent)					
Item[a]	15	20	25	30	35	SE
Daily gain, lb	.36	.40	.41	.46	.50	.03
Daily feed, lb	.68	.71	.74	.81	.83	.05

[a]Pigs were provided the above levels of dried whey for a 28-day postweaning period. Average initial weight was 9.6 pounds with each treatment mean representing 26 pigs.

Dried whey contains not only a highly digestible protein source but other nutrients, notably lactose (milk sugar). Consequently, another experiment was conducted to evaluate if lactose, when added to lower levels of dried whey, would further enhance pig performance. The treatment diets contained 15 and 25 percent levels of dried whey with or without added dietary lactose, provided at the same levels as that found in the 35 percent dried whey diet. The results from this experiment presented in Table 3 demonstrate that when dried whey was provided at 15, 25 or 35 percent, pig gains increased linearly at each dietary increment of the product source. However, when supplemental lactose was provided at each dried whey level, gains were further enhanced when it was incorporated. The largest relative gain improvement occurred when lactose was added to the 15 percent dried whey diet. These data suggest that the value of dried whey lies not only in its superior protein quality but also from its lactose contribution. The weanling pig thus effectively utilizes both nutrients to achieve optimum performance. Although gains were slightly higher when 35 percent dried whey was fed instead of 15 or 25 percent dried whey plus lactose, the differences did not differ significantly.

TABLE 3. EFFECT OF THREE LEVELS OF DRIED WHEY WITH OR WITHOUT SUPPLEMENTAL LACTOSE WITH WEANLING PIGS[a]

Item	Dried whey, %	15		25		35	
	Lactose added, %	0	10.2	0	5.1	0	SE
No. pigs		30	63	30	63	63	
Daily gain		.40	.46	.46	.48	.50	.02
Daily feed		.68	.68	.70	.75	.73	.02

[a]Pigs were provided the above diets for a 28-day postweaning period. Average initial weight was 9.4 pounds.

Perhaps other nutrients are more critical than we previously recognized during the postweaning stage. Selenium and(or) vitamin E are two nutrients where body reserves can be rapidly depleted upon weaning. This is particularly true for those regions where cereal grain concentrations are low in selenium. The work in Ohio, Michigan and Indiana suggest that the young weanling pig's dietary selenium requirement is greater than the currently approved level .1 ppm with suggestions up to .3 ppm.

The deficiency occurs principally with weanling swine the first two weeks postweaning. Generally, the largest, fastest growing pigs in the litter are most frequently afflicted with the deficiency, often dying suddenly within a few days of weaning with little or no outward clinical symptoms. Upon necropsy examination, light colored muscular tissue, particularly noticeable in the ham, along with a high incidence of edematous tissue in the heart cavity and intenstinal tract (i.e., gut-edema), are evident in these pigs. Factors such as complete confinement, corn-soybean meal formulated diets, breed, weaning stress and disease may be important in promoting the onset of this problem and ultimate death of the animal. Both selenium and vitamin E appear to be rapidly depleted in weanling pigs. The deficiency of either one aggravates the problem, but when both are depleted the onset of the deficiency disease is imminent. Thus, factors relating to the rate of these depletions such as weaning age, type of diet provided, type of confinement, etc., all contribute to the deficiency onset and(or) influence mortality rate losses. Our results in Ohio suggest that under such conditions the weanling pig diet may need to contain .3 ppm selenium.

Table 4 presents the effects of injecting vitamin E and selenium during the nursing phase and(or) at weaning with a commercial vitamin E-selenium product (BoSe). The results indicated that when no injection was provided, mortality losses averaged 4.7 percent, whereas, when administered either while the pigs were nursing or at weaning, mortality was reduced to 1.3 and 1.7 percent, respectively. It should be noted that death losses reported in this table were confirmed cases of the deficiency as evidenced by necropsy examination. No losses occurred from 21 days to weaning, but those that did occur during the postweaning period were within 3 to 10 days. Consequently, these results suggest that if the deficiency occurs in young swine, a single injection at weaning is effective in reducing mortality losses. It is our experience that the intramuscular administration of 1 to 2 cc BoSe (1 mg Se, 68 I.U. vitamin E/cc) at weaning when needed will reduce postweaning losses markedly.

TABLE 4. EFFECT OF INJECTABLE VITAMIN E-SELENIUM ON POSTWEANING MARTALITY

	Injectable E-Se Level[a]		
Item	0 + 0	1 + 2[b]	0 + 3[c]
No. pigs	494	300	458
No. deaths	23	4	8
Mortality, %	4.7	1.3	1.7
Avg. days death	7.5	7.0	6.1

[a]The diet contained .1 or .3 ppm supplemental selenium. The product injected contained 1 mg Se and 68 International units vitamin E per cc.

[b]1 cc was administered at 3 weeks of age and 2 cc at weaning.

[c]3 cc was administered at weaning

Vitamin C addition also has recently received some attention with weanling pig diets. Although this vitamin is synthesized by swine, it may be either inadequately synthesized or the requirement may be higher during the stressful weaning period. USDA workers (Yen et al., 1980) have suggested that weanling pigs will respond to vitamin C supplementation. Unpublished Ohio research presented in Table 5 confirms part of these observations, particularly during the first two weeks postweaning when growth and feed to gain rations were superior when 450 or 900 ppm vitamin C was added. It may be possible that weanling pigs may respond to supplemental ascorbic acid during a short period postweaning.

TABLE 5. EFFECT OF VITAMIN C IN POSTWEANING DIETS OF YOUNG SWINE

Item	Vitamin C addition (ppm)			SE
	0	450	900	
No. pigs	122	108	122	
Initial weight	15.3	15.4	15.0	.24
Daily gain, lb				
0 - 7 days	.20	.22	.22	.02
7 - 14 days	.57	.64	.62	.02
14 - 21 days	.87	.91	.88	.03
21 - 28 days	1.01	1.01	1.02	.03
Feed/gain				
0 - 7 days	3.09	2.32	2.30	.47
7 - 14 days	1.62	1.56	1.50	.06
14 - 21 days	1.62	1.64	1.65	.03
21 - 28 days	1.85	1.87	1.82	.06

The effectivenes of dietary antibiotics, particularly with young swine, is widely accepted, generally resulting in an approximate 15 percent growth advantage. Recent evidence from Ohio and Kentucky suggested that incorporated copper (250 ppm), in addition to the antibiotic, results in an additive growth response. The type of antibiotic used does not appear to greatly influence the increase with positive responses resulting from carbadox, chlortetracycline (with or without penicillin and sulfur), lincomycin, tylan and virginiamycin. The results in Table 6 present some of the Ohio data demonstrating these responses with weanling swine. These results suggest a benefit to the combination during the postweaning period.

The diets presented in Table 7 have incorporated the above and have been evaluated successfully on our farm.

TABLE 6. EFFECT OF ADDED ANTIBIOTICS AND COPPER SULFATE TO POSTWEANING PIG DIETS

	Antibiotic:	ASP-250		Lincomycin		Mecadox	
Item[a]	Cu, ppm:	0	250	0	250	0	250
No. pigs		52	55	38	62	27	39
Initial wt, lb		24.3	25.5	22.3	25.2	23.9	27.9
Daily gain, lb		.84	.93	.81	.87	.91	1.09
Daily feed, lb		1.26	1.55	1.28	1.51	1.49	1.76
Feed/gain		1.50	1.67	1.58	1.74	1.64	1.61

[a]The performance data reflect 0 to 14 day postweaning results.

TABLE 7. PERCENTAGE COMPOSITION OF SUGGESTED DIETS FOR WEANLING PIGS

	Pig Weight Range (lb)	
Ingredient	8 - 20	20 - 50
Corn	32.95	55.80
Soybean Meal, 44%	29.35	30.60
Oats, Rolled	10.00	10.00
Dried Whey	25.00	
Dicalcium phosphate	1.10	1.70
Limestone	.70	1.00
Selenium Premix[a]	.05	.05
Trace-Mineral Salt[b]	.35	.35
Vitamin Mix[b]	.15	.15
Antibiotic	.25	.25
Copper Sulfate[c]	.10	.10

[a]Level may need to be increased to a .3 ppm level to prevent deficiency problems with weanling pigs (not FDA approved).

[b]Amount per ton variable due to manufacture recommendations. If vitamin C is added, a level of 450 ppm is adequate.

[c]The addition of 1 to 2 pounds per ton up to 50 pounds body weight.

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PERFORMANCE OF BARROWS FED A WHEAT FINISHER RATION WITH DIFFERING PROTEIN SUPPLEMENTS

D. C. England, S. Tachasirinugune, W. H. Kennick and P. R. Cheeke
Department of Animal Science
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When costs of feedstuffs used primarily to provide adequate protein supplementation are high compared to grain, the cost/ton of ration can be cut by using less protein supplement or by using a lower-cost supplement source. Reducing cost/ton of ration is not by itself an economically suitable alternative unless it also results in reduced cost of total feed used to produce the same amount of pork. Any decrease in carcass quality sufficient to reduce selling price also must be taken into accout in assessing the economic effect of changes in protein level or source.

Recommended levels of crude protein in rations generally are designed to provide the minimum amount of each of the amino acids required for optimum performance at the stage of production involved. Decreasing the amount of protein supplement so it reduces protein content of rations below recommended levels frequently results in a slower rate gain and more feed required per unit of gain. As a consequence, feed cost may not be decreased and may even increase because total feed cost is the product of amount of feed required times cost per unit of feed. Inadequate level of protein in the ration also may result in fatter carcasses.

The recommended level of protein in rations is not for protein as such but for providing the required amino acids in appropriate amounts. Content of different amino acids, as well as total percent protein, varies in grains and in feedstuffs used as protein supplements. Soft white wheat grown in the Pacific Northwest is generally deficient in total protein content. In addition, it tends to be more deficient in lysine compared to needed amounts than in other amino acids. To the extent that protein deficiency exists in only one essential amino acid rather than in total protein quantity, it may be possible to provide a part of the needed protein supplementation at lower cost through adding the specific amino acid rather than by adding a protein supplement feedstuff.

Lysine, apart from its availability as a component of protein supplement feedstuff, is available as a specific entity. Therefore, it can be added to rations without adding a protein supplement feedstuff. To determine growth, feed efficiency and carcass quality response of barrows to (1) a reduced amount of soybean oil meal in a wheat-based finisher ration, and (2) addition of an amount of lysine needed to replace the amount removed from the ration by replacing a part of the soybean oil meal with wheat, feeding trials were conducted using the five rations shown in Table 1. Four groups of eight pigs each (32 total pigs per ration) were fed each of the five rations. Ration formulas and cost per ton are shown in Table 1. Average beginning and average ending weights are shown in Table 2 along with average daily gain and feed required per pound gain.

TABLE 1. FINISHER DIETS FED TO MARKET BARROWS

Ingredient (lbs/ton)	1	2	3	4	5
Wheat (10% C.P.)	1695	1820	1816	1882.5	1876.5
Soybean meal (44% C.P.)	250	125	125	62.5	62.5
TM Salt	10	10	10	10	10
Limestone	20	20	20	20	20
Dicalcium Phosphate	20	20	20	20	20
Shamrock Vit. Mix	5	5	5	5	5
Zinc Sulfate	340gram	340gram	340gram	340gram	340gram
L-Lysine			4		6
Calculated protein content	14.0	11.8	11.8	10.8	10.8
Cost/ton ($)	213.28	201.00	206.81	190.09	200.24

Rations 1, 3 and 5 are designed to be equal in lysine content but to have different total protein contents. Total dry matter and total digestible nutrients would be only slightly affected by substituting wheat for part of the soybean oil meal. Rations 1, 2 and 4 have different levels of crude protein content as well as associated differences in lysine content. Direct evaluation of effect of adding lysine to rations with two different levels of protein can be seen by comparing differences between Ration 2 versus 3 with difference between Ration 4 versus 5.

Statistical analysis of the data (Table 2) indicates differences in average daily gain and feed efficiency as large as those among Rations 1, 2, 3 and 5 have more than a 5 percent probability of occurring because of chance alone in feeding trails conducted as this one was; differences in average daily gain and feed efficiency shown in Table 2 are not considered to be significantly different among Rations 1, 2, 3 and 5. Differences as large as those between Ration 4 (low soybean oil meal and no added lysine) and each of the other rations would be expected to occur by chance alone in less than 1 percent of experiments conducted to test performance among these rations. Average daily gain and feed per pound gain, therefore, are considered to be significantly less adequate for pigs fed the ration with only 62.5 pounds of soybean oil meal with no added lysine than for any of the other rations.

TABLE 2. AVERAGE DAILY GAIN, FEED EFFICIENCY AND CARCASS TRAITS OF BARROWS FED WHEAT FINISHER RATIONS WITH DIFFERENT AMOUNTS OF SOYBEAN OIL MEAL WITH AND WITHOUT ADDED LYSINE

Ration[1]	Av. initial wt.	Av. final wt.	lbs. ADG	Av. FE	Actual cost/lb gain(¢)	Hypothetical cost/lb gain(¢)	Carcass length (in)	Carcass B.F. (in)
1. 250 SBOM No added lyisne	123	220	1.83	3.40	36.2	36.2	30.5	1.30
2. 125 SBOM No added lysine	122	216	1.74	3.65	36.7	34.2	30.7	1.34
3. 125 SBOM 4 lbs added lysine	122	221	1.81	3.55	36.7	35.2	30.1	1.35
4. 62.5 SBOM No added lysine	120	214	1.34*	4.38*	41.6	41.6	31.0	1.38
5. 62.5 SBOM 6 lbs added lysine	120	220	1.69	3.83	38.3	34.2	30.8	1.35

[1]Figures denote lbs of soybean oil meal and lysine respectively/ton of feed.
*Values are significantly different ($P<.01$) from those of other rations for this trait.

In this experiment, replacement of 125 pounds of the 250 pounds soybean oil meal with a like amount of wheat did not significantly decrease performance for either gain or feed efficiency. Since it did not, it is not surprising that there was no significant benefit from adding lysine (Ration 3) equivalent to the amount reduced by replacing 125 pounds of soybean oil meal with wheat.

Replacement of three-fourths (187.5 pounds) of the 250 pounds of soybean oil meal in the ration with wheat (Ration 4) significantly depressed gains and feed efficiency; addition of lysine (Ration 5) in amount equivalent to the decreased lysine content from replacement of soybean oil meal by wheat had a statistically significant beneficial effect on growth rate and feed efficiency. With the added lysine, performance for these traits was not significantly different from performance on rations having either 125 pounds or 250 pounds of soybean oil meal.

Cost/ton for each ration, including cost of lysine at $1.90/ton, is shown in Table 1; cost/pound of gain is shown in Table 2. On the basis of actual feed consumed and cost/ton for the ration, difference in costs of gains was negligible for the ration containing 250 pounds of soybean oil meal, the one containing 125 pounds of soybean oil meal, and the one containing 125 pounds of soybean oil meal plus added lysine. Reduction of soybean oil meal to 62.5 pounds per ton with addition of lysine increased costs/pound of gain from either 36.2¢ or 36.7¢ for the ration with higher soybean oil meal content to 38.3¢. The ration with only 62.5 pounds of soybean oil meal without added lysine increased cost/pound of gain to 41.6¢--an increase of 5¢ per pound. Differences in carcass length and backfat thickness were small and not significantly different for barrows fed the different rations.

Even though 32 pigs were used for four test groups per ration, the scope of this feeding trial is not sufficient to adequately assess whether use of lysine to replace part of the soybean oil meal, as was done in this trial, usually will lower cost of gains. This is so because differences in performance were not significant even though they were consistent. If the average daily gains, feed efficiency and carcass traits are not changed by the substitution, the decreased cost of rations resulting from substituting lysine for part of soybean oil meal automatically would reduce cost of gains when ration cost/ton is decreased. In this experiment, except for Ration 4, performance was actually different but within a range which could be expected to occur by chance alone often enough to result in the differences seen. Costs of gains calculated on actual differences in this experiment do not show the advantages which would result if it is concluded that on average performance results on Rations 1, 2, 3 and 5 would not differ from each other.

Cost per pound of gain with such performances is shown as hypothetical cost per pound gain and should be interpreted as the most favorable probable extreme. To the extent that actual performances are not equal and are inferior to the optimum ration, cost advantages of rations with lower performance would disappear and could become disadvantageous as shown in the actual cost column of Table 2.

SUMMARY AND CONCLUSIONS

Replacement of 125 pounds of the 250 pounds of soybean oil meal from a 14 percent crude protein wheat-based finisher ration resulted in actual but not significantly reduced average daily gain and feed efficiency for barrows. Addition of lysine to replace that removed by the exchange of soybean oil meal for wheat did not have significant effect on performance.

Replacement of 187.5 pounds of the soybean oil meal with wheat did result in highly significant decrease in average daily gain and feed efficiency. Addition of lysine to replace that removed by the exchange of soybean oil meal for wheat significantly improved the ration having the low soybean oil meal content.

With actual costs of rations and actual feed required per pound of gain, reducing the amount of soybean oil meal, with or without addition of lysine, failed to reduce cost of gains even though ration costs per ton was decreased. Cost of gains was increased by replacement of three-fourths (187.5 pounds) of the soybean oil meal, with or without lysine supplementation.

Cost effects of the ration changes would automatically be determined by differences in cost per ton of ration.

LITTER PRODUCTION BY GILTS OF DIFFERENT WEIGHTS

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The long-standing recommendations for mating gilts at third estrus or at about eight months of age appear to have been based in part on historical predominance of producer programs in which farrowing occurred primarily during spring and fall seasons. In this system, gilts would generally be about eight months of age during the usual breeding season. The age-at-mating pattern was reinforced by research which showed increasing numbers of eggs ovulated with each succeeding heat period. Thus, the traditional production system and the biology of reproduction of gilts were in harmony. As the trend to year-round farrowing developed and intensified, increased investment in buildings and equipment intensified need for farrowing at more frequent intervals in the herd as a whole and by each individual. This need for maximum intensity of farrowing has contributed to interest in earlier reproduction by gilts.

Early research comparing litter production of gilts mated at first versus third estrus (Brooks and Cole, 1973; Libal and Wahlstrom, 1976) and a more recent report (Young and King, 1981) tend to show relatively small differences in numbers of pigs born and weaned. There is an average of about 42 days between first and third estrus. Economic advantage of the added number of pigs weaned per litter from mating at third versus first estrus must take into account cost of the added days of feed and care required to get the gilt from first to third estrus.

At least two of the above studies observed increased time from weaning of first litter to occurrence of postweaning estrus by gilts mated at first estrus compared to gilts mated at third estrus. Libal and Wahlstrom (1976) reported that a higher percent of gilts mated at first estrus failed to produce a second litter compared to gilts mated at third estrus. Any added "non-productive" time cost from delayed postweaning mating as well as differences in number of pigs produced per litter must be considered in evaluating the most economical estrual period to mate gilts.

Another potential means of decreasing feed costs of gilts before mating would be by stimulating occurrence of initial estrus at lower weight with occurrence of succeeding estrus periods at usual intervals and mating at third estrus. Knott (1980) reported cycling data, ovulation rates, conception percentages and embryo survival to 28 days of gestation for gilts of two groups of different weight at exposure for cycling and at mating. The groups weighed an average of 242 pounds and 262 pounds, respectively, at mating at third estrus. Results were not significantly different for the two weight groups for any of these reproductive traits and were fully numerically equal for the lighter-weight group.

Authors of the present report are conducting research to evaluate the role of heredity in differences in adequacy of cycling by gilts. Weight of gilts in that experiment ranged from 160 pounds to 210 pounds at time of allotment for estrus stimulation. In relation to weight of gilts at allotment for cycling, the present paper reports days from allotment to first estrus and to breeding at third estrus, litter productivity, weight changes of gilts during gestation and lactation and days from weaning of first litter to postweaning estrus.

MATERIALS AND METHOD

Yorkshire gilts were exposed for estrus stimulation at weights ranging from about 166 pounds to 210 pounds. They were established in pen groups in the brood stock unit by mixing gilts from different confinement-rearing pens in another building. All gilts had daily exposure to a mature boar for heat check. All gilts were checked for at least 42 days or until occurrence of first estrus during that time. Those which cycled for second estrus within 30 days after first estrus were kept for cycling for third estrus. Gilts which reached second estrus but didn't cycle for third estrus within 30 days were removed. Those which exhibited third estrus were mated at that time.

By chance, allotment age was the same for the group with average initial weight of 160 pounds and the one with average initial weight of 181 pounds. The third group, with average initial weight of 195 pounds, was eight days older than the other two groups. Thus, ages were similar for the three groups.

RESULTS

One aspect of analysis of the data has focused on time to first estrus, to breeding at third estrus, and to farrowing by gilts of the three initial weight groups which were significantly different ($P<.05$). By chance, the lowest and middle weight groups were of almost identical age at allotment and the heaviest group was only one week older. Age of the groups at time of exposure would therefor not be expected to have an important influence on any differences among the three groups. Differences in average days to first estrus, therefore, would be attributable to differences in weight rather than age. Days from beginning of the experiment to first estrus were 30, 28 and 27 for the three groups, respectively, from lightest to heaviest (Table 1). These times are not significantly different and are in agreement with reports of previous research (Schiemann _et al._, 1975, and Knott, 1980) from this station and with this herd.

TABLE 1. AGE AND WEIGHT AT VARIOUS STAGES OF PRODUCTION FOR GILTS OF DIFFERENT WEIGHT AT ALLOTMENT FOR CYCLING

	Weight (pounds)			Age (days)		
Stage of Production	Low	Medium	High	Low	Medium	High
Allotment	166[a]	181[b]	195[c]	182[a]	182[a]	190[a]
First estrus	201[a]	215[b]	225[c]	212[a]	210[a]	217[a]
Breeding	248[a]	261[b]	271[c]	255[a]	251[a]	260[a]
110 days gestation	384[a]	394[b]	409[c]	372[a]	371[a]	376[a]

[a, b, c]Within trait, values in horizontal rows having different superscript are significantly different (P<.05). Values having the same superscript are not significantly different.

Days from first estrus to breeding at third estrus were 43, 41, and 43 for the three groups, respectively; average time between cycles, therefore, was not affected by size differences among the groups. Average days from mating to farrowing were 117, 120 and 116, respectively, for the three weight groups. If a 114-day average gestation is assumed, number of days "lost" through rebreeding was equal to 14, 29 and 10 percent of the gilts remating 21 days after mating at third estrus. Average age was not significantly different among the three groups at any of the stages of production shown in Table 1. It can be concluded that allotment for cycling at the different weights did not cause differences in time from allotment to farrowing.

A second focus of data analysis was litter productivity, weight loss during lactation, and occurrence of postweaning estrus by gilts of the three groups. These data are summarized in Table 2. From these data it can be seen that gilts of the lower initial weight group had significantly more pigs born alive and weaned per litter with an average 10.2 born and 8.7 weaned. Average weaning weight per pig was highest for litters from the group of heaviest gilts. The number of gilts in the heaviest group is too small to be used as highly reliable information. It is evident, however, that litter productivity of the gilts allotted for cycling at the lower weights is also an important aspect of maximizing pigs produced per sow year. In this respect, the three groups were not significantly different and cycling was within a very acceptable average time of 7 days for 93, 96 and 70 percent which cycled after weaning. With anly 10 dams in the heavier group, the 70 percent which cycled versus 93 and 96 percent cannot be

TABLE 2. LITTER PRODUCTIVITY AND SOW TRAITS OF GILTS EXPOSED FOR CYCLING AT DIFFERENT WEIGHTS

	Averages for Birth Traits			Averages for Traits at 42 Days			
Groups	No. of litters	No. born alive	Birth wt.	No. of litters	No. pigs/per litter	Weaning wt. (lbs)	Percent survival
Lowest weight group	57	10.2^{a}	2.5^{a}	54	8.7^{a}	15.6^{a}	85
Middle weight group	24	9.5^{b}	2.6^{a}	21	7.3^{b}	16.4^{a}	77
Highest weight group	10	8.6^{c}	2.7^{a}	10	8.0^{c}	20.1^{b}	93

SOW TRAITS

Groups	No. of dams	Wt. at 110 days gestation	Lactation wt. loss	Days from weaning of litter to estrus	Percent cycled
Lowest weight group	57	384^{a}	64^{a}	7.1^{a}	93
Middle weight group	24	394^{b}	63^{a}	5.6^{a}	96
Highest weight group	10	409^{c}	73^{b}	6.7^{a}	70

[a, b, c]Within traits, values in vertical columns having different superscript are significantly different ($P<.05$). Values having the same superscript are not significantly different.

realistically construed as a true representation of a larger population. Of key importance to production of more pigs per unit of time is the occurrence of satisfactory cycling by the gilts from the group which was of lower weight at allotment for cycling and which also nursed the highest average number of pigs per litter. Loss of weight during lactation was not significantly different among the three groups.

Litter production data were also analyzed on the basis of groups having different weights at breeding. Average time from allotment to breeding was 72, 68 and 70 days for the three groups of different weights at allotment. During this time, differences in weight gains by individuals would create different populations on a weight-at-breeding versus weight-at-allotment basis. Performance was analyzed for three weight-at-breeding groups with average weights of 232, 254 and 275 pounds (Table 3). These analyses also show the lighter gilts to produce as many live pigs at birth and significantly more ($P<.05$) at weaning and to cycle as adequately postweaning as did the other two groups.

SUMMARY AND CONCLUSIONS

Gilts were allotted for cycling at weights ranging from about 160 to 200 pounds. For analysis of relationship of weight to litter productivity, data were analyzed for those three groups with average allotment weights of 166, 181 and 195 pounds, respectively. Number of days to first estrus and to breeding at third estrus was similar and not significantly different for the three groups. Gilts from the group of lowest weight at allotment farrowed and weaned significantly more pigs per litter than either of the other two groups. Average weaning weight was significantly heavier for litters from gilts heaviest at allotment. Weight loss during lactation, and adequacy of cycling following weaning of the first litter, were similar for the three groups. When data were analyzed for weight-at-breeding groups irrespective of initial allotment weights, litter productivity and postweaning cycling adequacy were similar for the three groups with number weaned per litter being significantly larger for the group with lower weight at mating.

From the results, it is concluded that producticity of gilts of differing weights within the range of those used in this experiment is not adversely affected by the lower allotment and breeding weights when bred at third estrus.

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TABLE 3. LITTER PRODUCTION AND SOW TRAITS OF GILTS BRED AT DIFFERENT WEIGHTS

LITTER TRAITS

Groups	No. of litter	No. born alive	Average birth wt.	No./litter at 42 days	Average weaning wt.	Percent survival
Lowest weight group	20	10.1^{a}	2.5^{a}	9.0^{a}	15.6^{a}	89
Middle weight group	52	10.0^{a}	2.6^{a}	8.2^{b}	16.3^{a}	82
Highest weight group	19	9.6^{a}	2.5^{a}	7.9^{b}	16.4^{a}	82

SOW TRAITS

Groups	No. of dams	Wt. at 110 day gestation	Lactation wt. loss	No. of dams	Days from weaning to estrus	Percent cycle
Lowest weight group	20	378^{a}	66^{a}	18	6.2^{a}	90
Middle weight group	52	389^{b}	66^{a}	48	7.2^{a}	92
Highest weight group	19	405^{c}	64^{a}	16	5.3^{a}	84

$^{a, b, c}$Within trait, values in vertical rows having different superscript are significantly different ($P<.05$). Values having the same superscript are not significantly different.

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PRODUCTION RESPONSE BY SWINE TO DIETS WITH HIGH ALFALFA CONTENT

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The higher price of ration ingredients in the Pacific Northwest, caused by a climate not favorable to producing corn and soybeans, is the major economic disadvantage to producing swine in the Pacific Northwest compared to the Midwest. Use of small-grain cereals, when prices are favorable, provides a locally produced alternative to corn but feedstuffs comparable to soybeans are not produced in major quantities in the Pacific Northwest. Transportation costs of importing feedstuffs from the Midwest to the Pacific Northwest increase feed costs without increasing efficiency so feed importation costs have negative effects on opportunity for profit.

The Pacific Northwest climate is conducive to producing alfalfa. Alfalfa has frequently been effectively and economically utilized in gestation rations and to some extent in finisher rations, but is generally not a major component of finisher rations. Results of several experiments conducted to evaluate influence of various levels of alfalfa in market hog rations have been reported at previous OSU Swine Days and have been summarized in a report by England et al. (1979). In general, results were:

1. Substitution of alfalfa for 10 percent or more of grain in the ration reduces average daily gain and increases feed required per pound of gain.

2. Reduced average daily gain and increased feed per unit of gain are greater with barley rations than with corn or milo rations. This result is interpreted to be caused by reduction of energy content of the ration to critically lower levels by substituting alfalfa in barley rations which are already lower in energy than corn or milo rations.

3. Inclusion of the antibiotic ASP-250 in a wheat-based ration in which 40 percent of the wheat was replaced by alfalfa has resulted in gains and feed efficiency equivalent to a wheat ration with only 20 percent of the wheat replaced by alfalfa without inclusion of the antibiotic.

These experiments also indicate that average daily feed intake (including differences in feed wastage that may have occurred) generally was not markedly changed by inclusion of alfalfa at various levels of substitution for grain. Powley et al. (1981) concluded that reduced daily energy intake is the essential cause of reduced daily gains when alfalfa levels in the ration are increased. Baird, McCampbell and Allison (1970) concluded that daily energy intake, not fiber content of the ration, is responsible for performance and carcass changes resulting from feeding high fiber rations.

Since alfalfa is locally produced in the Pacific Northwest, research has been conducted at Oregon State University to evaluate whether selection among animals in the herd could be a means of improving performance on rations containing 40 percent alfalfa instead of grain in the finisher ration. This report summarizes growth rate, feed efficiency and carcass information for gilts and barrows used in an experiment, and also summarizes litter productivity at first farrowing by gilts fed rations containing 40 percent alfalfa instead of grain in the finisher ration compared to those fed a conventional finisher ration. After a performance test on their respective rations during the finisher period, all gilts used to produce litters were fed conventional rations until bred, during gestation and during lactation.

EXPERIMENTAL PROCEDURE

All pigs allotted to the experiment were fed a 16 percent crude protein ration from weaning to approximately 60 pounds. From 60 pounds (Phase 1), full sib or half-sib pairs of gilts and of barrows were allotted to individual pens and fed ad lib a 14 percent crude protein wheat-based ration. One member of each sib pair was randomly allotted to continue on the conventional ration from 125 pounds to 200 pounds and the other was allotted to the 40 percent alfalfa ration. Thus, from 125 pounds to 200 pounds, designated as Phase 2, one pig of each pair continued to be fed the conventional ration while the other was fed a 40 percent alfalfa ration. The rations (Table 1) were similar except that the alfalfa ration contained 800 pounds of alfalfa per ton instead of the same quantity of wheat used in the conventional 14 percent crude protein ration. At 200 pounds, the pigs were either slaughtered for carcass data, allotted to another related alfalfa experiment or entered the breeding herd.

RESULTS

A summary of production by gilts fed the two different rations is shown in Table 2. During Phase 1, when all pigs were fed the 14 percent conventional ration, average daily gains (ADG), feed efficiences (FE) and daily feed intakes were similar for the groups to be fed the different rations in the finisher period. During Phase 2, however, there were differences in performance on the two rations in average daily gain and feed efficiency for the entire period. Average daily gains during weeks 1, 2 and 3 after a change to the 40 percent alfalfa ration were anlayzed to assess the immediate response to the high alfalfa ration and whether and when adjustment to it occurred. There was a marked immediate interruption in growth because of change to the alfalfa ration; on average,

TABLE 1. RATION COMPONENTS (pounds)

Ingredients	40% Alfalfa	Control
Wheat	800	1695
Soybean oil meal	260	250
T M salt	10	10
Zinc sulphate	.75	.75
Sun-cured alfalfa	800	
Molasses	100	
Bentonite	40	
Monosodium P	20	
Vitamin D		200,000 IU
Vitamin B_{12}	15 gms	
ASP 250	5	
Limestone		20
Dicalcium Phosphate		20
Shamrock Vitamin mix		5
Digestible Energy (kcal)	2788	3619
% Protein	14	14

TABLE 2. PERFORMANCE OF GILTS FED CONVENTIONAL OR NON-CONVENTIONAL (40% Alfalfa) FINISHER RATIONS

Group	ADG Phase 1[1] (lbs)	ADG Phase 2 (lbs)	ADG Wk 1 Ph 2 (lbs)	ADG Wk 2 Ph 2 (lbs)	ADG Wk 3 Ph 2 (lbs)	FE Phase 1	FE Phase 2	Daily feed intake Phase 1	Daily feed intake Phase 2	Live backfat[2] (in)
Number										
Conventional	87	91	91	91	89	82	85	82	85	55
40% Alfalfa	120	127	127	127	127	111	120	111	120	71
Mean Performance										
Conventional	1.58	1.87	1.76	1.80	1.84	3.28	3.76	5.12	6.74	1.01
40% Alfalfa	1.61	1.68	1.28	1.62	1.68	3.37	4.75	5.12	7.10	.90
SD										
Conventional	.25	.45	.51	.51	.56	.74	1.05	1.14	1.27	.49
40% Alfalfa	.71	.70	.51	.53	.84	.87	1.48	1.36	1.52	.73

[1] Phase 1 and Phase 2 were, respectively, from 60 to 125 pounds and 125 to 200 pounds.

[2] Measured by mechanical probe.

adjustment to the high alfalfa ration occurred by the third week. Large differences in average daily feed intakes of the two rations during the entire period were not apparent; feed intakes were not measured on a weekly basis. Average live backfat (BF) as measured by mechanical probe was about one-tenth of an inch less at 200 pounds weight for gilts fed the 40 percent alfalfa diet.

Information on production traits and carcass measurements of barrows fed as reported above for gilts is shown in Table 3. On the conventional ration in Phase 1, barrows consumed about the same amount of feed daily as gilts did, gained more per day and, thus, used less feed per pound of gain. Gains by barrows fed the 40 percent alfalfa ration in Phase 2 were similar to gains made by gilts fed the same ration, whereas, barrows fed the conventional ration in Phase 2 had gains superior to those for gilts fed the conventional ration (Tables 2 and 3). Daily feed intake on the 40 percent alfalfa ration tended to be higher by barrows than by gilts. Barrows also tended to be less efficient in the finisher period at converting feed into gains on each of the rations (Tables 2 and 3). Lower dressing percentage and less backfat were the only appreciable carcass differences between barrows fed the two rations.

A non-linear relationship existed between average daily temperatures and the amount of daily feed intake and the resultant feed efficiency in the finisher period. Thus, relative economic value of substituting high levels of alfalfa for a like amount of wheat depends not only on relative price of the two feedstuffs but also on temperatures when the rations are fed. Table 4 contains a summary of the effect of temperature on performance of gilts on the two rations during times of different average temperatures.

Conventionally fed gilts were superior to the alfalfa ration fed gilts in all temperature ranges and particularly so during the colder weather. This response coincides with the period when the lower energy content of the 40 percent alfalfa ration would be expected to be proportionally least adequate. Feed efficiencies tended to improve and daily feed intake tended to decrease as temperature increased. There was no apparent consistent effect of temperature on backfat thickness.

Using the feed efficiencies achieved during the four temperature periods and ignoring the observed growth differences, a guide to break-even feed cost of using alfalfa to replace 40 percent of wheat can be determined fom information in Table 5.

The summary in Table 5 shows the amount of alfalfa used and the amount of

TABLE 3. PERFORMANCE AND CARCASS DATA OF BARROWS FED CONVENTIONAL OR NON-CONVENTIONAL (40% Alfalfa) FINISHER RATIONS

Group	ADG Phase 1 (lbs)	ADG Phase 2 (lbs)	ADG Wk 1 Ph 2 (lbs)	ADG Wk 2 Ph 2 (lbs)	ADG Wk 3 Ph 2 (lbs)	FE Phase 1	FE Phase 2	Daily feed intake Phase 1	Daily feed intake Phase 2
PERFORMANCE									
Number									
Conventional	16	16	15	15	15	14	14	14	14
40% Alfalfa	16	18	18	18	18	12	15	12	15
Mean Performance									
Conventional	1.81	2.09	1.99	2.35	2.02	2.99	3.99	5.50	7.84
40% Alfalfa	1.83	1.64	1.36	1.58	1.83	2.88	4.96	5.20	7.74
SD									
Conventional	.19	.34	.69	.59	.54	.60	.83	1.45	1.34
40% Alfalfa	.18	.28	.60	.72	.74	.61	1.31	1.20	1.63

CARCASS TRAITS

Group	No.	Slaughter weight (lbs)	Carcass weight (lbs)	Dressing percent	Carcass length (in)	Backfat (in)	LEA (sq. in)	Loin wt. (lbs)	Ham wt. (lbs)	Color score[1]	Marbling score[2]
Conventional	36	222	168.6	75.9	30.3	1.48	4.46	27.7	33.2	2.9	2.7
40% Alfalfa	36	217	159.3	73.4	30.2	1.30	4.37	26.6	32.8	2.9	2.5

[1] 2=Slightly pink
3=Grayish or "normal"

[2] 2=Slight amount of marbling
3=Small amount of marbling

TABLE 4. PERFORMANCE OF GILTS ON CONVENTIONAL OR 40% ALFALFA FINISHER RATIONS DURING DIFFERENT MEAN TEMPERATURE PERIODS

Temperature	ADG[2] Week 1	ADG[2] Week 2	ADG[2] Week 3	ADG (T)[2] 125-200 lbs	FE 125-200 lbs	Daily feed intake 125-200 lbs	Live backfat thickness @ 200 lbs
30-39°F							
Conventional (14)[1]	1.45	1.74	1.79	1.73	4.73	7.60	.99
40% Alfalfa (12)	1.20	1.50	1.18	1.33	6.96	8.67	.84
40-49°F							
Conventional (27)	1.76	1.80	1.92	2.02	3.61	6.77	.94
40% Alfalfa (33)	1.31	1.73	1.69	1.65	4.52	7.16	.80
50-59°F							
Conventional (10)	1.94	1.99	1.67	1.89	3.61	6.73	.93
40% Alfalfa (20)	1.26	1.64	1.59	1.71	4.97	7.52	.89
60°F or Higher							
Conventional (32)	1.83	1.77	1.84	1.81	3.53	6.37	1.07
40% Alfalfa (52)	1.29	1.56	1.69	1.67	4.33	6.49	.80

[1] Numbers in () refer to number of animals

[2] These headings refer to times following allotment to conventional or 40% alfalfa rations from 125 pounds to 200 pounds weight.

TABLE 5. AMOUNT OF ALFALFA REQUIRED TO REPLACE A POUND OF WHEAT DURING PERIODS OF DIFFERENT AVERAGE TEMPERATURES

Item	30-39°F	40-49°F	50-59°F	≥60°F
Alfalfa used	208.80	135.60	149.10	129.90
Grain saved	41.55	67.35	47.10	69.90
Ratio of alfalfa used to wheat saved	5.03:1	2.01:1	3.17:1	1.86:1
1 Pound of wheat	5.03	2.01	3.17	1.86

TABLE 6. AVERAGE DAILY GAINS OF GILTS FED RATIONS CONTAINING 97% ALFALFA AFTER REACHING 200 POUNDS WEIGHT

Group[1]	1st Week post 200 lbs	2nd Week post 200 lbs	3rd Week post 200 lbs	4th Week post 200 lbs
Number				
Conventional	21	21	21	21
40% Alfalfa	32	32	31	31
Mean ADG (lbs)				
Conventional	-1.73	- .25	.33	- .01
40% Alfalfa	-2.36	.15	.05	.23
SD				
Conventional	.82	.58	.63	.67
40% Alfalfa	1.13	.83	.92	.98

[1] From 125 pounds to 200 pounds.

grain "saved" during the period from 125 pounds to 200 pounds at each of the temperature ranges. The ratio between alfalfa used and grain saved is shown. This summary indicates that at temperatures of 30 to 39°F, each pound of grain "saved" required use of 5.02 pounds of alfalfa. At temperatures of 40 to 49°F, 2.01 pounds of alfalfa in the ration provided the same amount of gain as 1 pound of wheat; at 50 to 59°F, 3.17 pounds of alfalfa in the ration resulted in "saving" 1 pound of wheat; at temperature of 60°F or higher, 1.86 pounds of alfalfa in the ration produced the same amount of gain as 1 pound of wheat. Thus, when the amount of grain "saved" can be purchased for less than the cost of alfalfa used to replace it, inclusion of alfalfa in the ration in replacement for wheat would not reduce feed costs. The slower growth rates which occur with inclusion of the high level of alfalfa would usually increase non-feed costs also.

The above figures are not consistent enough over the temperature ranges to be taken at face value. Data on very large numbers of animals would be needed to provide high accuracy of such information. Also, data for group-penned animals would be expected to show less adverse effects of low temperatures because of expected lower heat loss of pigs kept in groups. The data reliably emphasize, however, that replacement of grain by alfalfa is less likely to be economically beneficial during periods of low temperature than during warmer weather.

In a separate small-scale experiment, feeding rations containing approximately 97 percent alfalfa to bred gilts during gestation resulted in severely adverse weight changes for many gilts. It was decided, therefore, to determine whether gilts fed a ration containing 40 percent alfalfa during the finisher period would have become "adapted" to high alfalfa rations and thus respond more favorably to a 97 percent alfalfa ration after reaching 200 pounds weight than would gilts not previously fed alfalfa in the ration.

At 200 pounds, gilts from both finisher rations were changed to a 97 percent alfalfa ration for four weeks. Weights were collected each week; gilts were then switched back to the conventional wheat-based ration. Average daily weight change during each week the gilts were fed the 97 percent ration are shown in Table 6.

The group fed the 40 percent alfalfa ration during Phase 2 averaged a loss of 2.36 pounds per day the first wek on the 97 percent alfalfa ration and gained slightly the remaining three weeks. Gilts previously fed the conventional ration lost 1.73 pounds/day during the initial week and continued to lose .25 pounds/day during the second week. After the second week, neither group gained or lost appreciably although there was variation in weight status within each group. Pigs fed the conventional ration from 125 pounds to 200 pounds and those fed the 40 percent alfalfa ration during that period averaged a loss of .42 pounds and .48 pounds per day, respectively, during the four-week test they were fed the 97 percent alfalfa ration. Thus, feeding a 40 percent alfalfa ration during the finisher period did not condition or adapt gilts to perform more adequately on a 97 percent alfalfa ration. When placed on the conventional ration after four weeks on the 97 percent ration, there was no appreciable difference in rate of recovery of the weight lost during the four weeks on the 97 percent alfalfa ration.

Comparative time from on-test weight at 60 pounds to farrow, days from 200 pounds weight to conception, and productivity at first litter by gilts reared from 125 to 200 pounds in the two nutritional finishing environments are shown in Table 7. After reaching 200 pounds weight, gilts from both finisher rations were managed alike and were fed conventional prebreeding, gestation and lactation rations. Essentially, there were no differences in any reproductive traits. Differences in days to conception from the end of finisher ration comparisons at 200 pounds weight are not meaningfully different and would include any differences in gain from 200 pounds to breeding weight and any differences in ability to conceive readily. It is concluded that no adverse or beneficial effects on litter productivity resulted from feeding one of the finisher rations versus the other when followed by feeding conventional rations after entering the brood stock herd.

SUMMARY

1. Gilts and barrows gained faster and were more efficient in using feed when fed a conventional wheat-based ration than when fed a 40 percent alfalfa ration from 125 pounds.

2. Barrows gained faster on the conventional ration than did gilts but gained similarly when fed the 40 percent alfalfa diet.

3. Gilts were more efficient than barrows and consumed less per day on the average during the finishing period.

4. Low temperatures reduced daily gains, increased feed/unit of gain and resulted in higher daily feed intakes.

5. Low temperatures had more adverse effect on pigs fed the 40 percent alfalfa energy-deficient diet than on pigs fed the conventional ration.

6. With present relative prices of grain and alfalfa, feeding 40 percent alfalfa rations to market hogs is not economically feasible with effects encountered on growth and feed efficiency in this experiment. Changes in prices which reduced cost of alfalfa relative to grain would encourage utilization of alfalfa during warmer months sooner than in colder temperature months.

7. The major effect of the 40 percent alfalfa ration on carcass data was some reduction in backfat thickness.

TABLE 7. FIRST LITTER PRODUCTIVITY OF GILTS FED CONVENTIONAL OR NON-CONVENTIONAL (40% Alfalfa) FINISHER RATIONS

Group	Days from 200 lbs to conception	Days from 60 lbs wt. to farrow	Number born alive	Litter birth weight	Number weaned	Weaning weight (lbs)	Number alive 21 days	Weight 21 days (lbs)
Mean Performance								
Conventional	87 (22)[1]	231 (21)	9.50 (22)	26.0 (21)	7.55 (21)	132.65 (20)	7.95 (20)	79.15 (20)
40% Alfalfa	93 (40)	243 (38)	9.50 (40)	26.31 (40)	7.90 (40)	130.92 (36)	8.07 (39)	82.32 (34)
SD								
Conventional		49.57	2.87	8.74	2.89	87.41	2.56	25.90
40% Alfalfa		66.54	2.94	13.53	2.86	58.80	2.38	26.75

[1]Number in parenthesis refers to number of litters for each trait.

8. Feeding 49 percent alfalfa rations during the finisher period did not adapt gilts to a more effective response to a 97 percent alfalfa ration after reaching 200 pounds.

9. Productivity at first litter of gilts fed conventional versus 40 percent alfalfa rations from 125 pounds to 200 pounds was not different. Interval from reaching 200 pounds weight to farrowing was negligible for the two groups.

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