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To the Graduate Council:

I am submitting herewith a thesis written by Howard W. Miller entitled "Levels and Sources of Phosphorus for Growing-Finishing Swine." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

Charles S. Hobbs
Major Professor

We have read this thesis
and recommend its acceptance:

Samuel A. Guiffa
Henry Anderson

Accepted for the Council:

Dale Hartling
Dean of the Graduate School

LEVELS AND SOURCES OF PHOSPHORUS
FOR GROWING-FINISHING SWINE

A THESIS

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The Graduate Council
of
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Howard W. Miller

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CHAPTER I

INTRODUCTION

Confinement feeding of swine is on the increase in Tennessee and in the South. With this change in the method of raising hogs, there is a need to carefully consider the adequacy of rations and supplements commonly used for feeding on pasture when used for confinement feeding on concrete. It is especially important to consider minerals and trace minerals in these rations. Phosphorus is one of the essential minerals that must be considered in swine rations.

In the past we have depended upon cereal grains, bonemeal, tankage, meat scraps and certain protein supplements as sources of phosphorus for swine. Today, we have several commercial sources available for incorporation into swine rations. The commercial sources differ widely in phosphorus and calcium content.

The purpose of this investigation was to evaluate the availability of phosphorus from common commercial phosphorus supplements for growing-finishing swine. The common commercial phosphorus supplements used for comparison in this experiment were wet process acid dicalcium phosphate, electric furnace acid dicalcium phosphate, defluorinated rock phosphate and Curacao Island phosphate.

CHAPTER II

REVIEW OF LITERATURE

Henry (1889) initiated the specific problem of phosphorus studies in swine by adding bonemeal to the ration of corn-fed pigs and reported an increase in the ash content and the strength of bones.

Bohstedt et al. (1926) found that the phosphorus of the blood varied markedly in relatively direct proportion with the phosphorus content of the ration.

Aubel et al. (1935) in a series of experiments to determine a minimum phosphorus level in swine rations reported that the minimum requirement of phosphorus in the ration of growing pigs was between 0.27 per cent and 0.30 per cent. Abnormalities that developed on low phosphorus rations were as follows: (1) lowering of inorganic phosphorus in the blood, (2) a failure of normal growth, (3) poor utilization of feed, (4) anorexia and (5) thirst and greater excretion of urine.

According to Shrewsbury and Vestel (1945) addition of phosphate supplements to practical swine rations resulted in improved daily gains and in some cases prevented bone abnormalities from developing.

Beeson (1957) reported that one of the basic problems when studying the availability of phosphorus for any

species is that a minimum phosphorus requirement level must be established to get critical tests. This minimum phosphorus requirement level would appear to be 0.30 per cent in the diet of swine.

Jordan et al. (1957) reported in a comparison of phosphorus and protein levels necessary for growing-finish-ing swine on legume pasture that the optimum phosphorus on pasture should be 0.45 per cent. Their results showed that on a 10 per cent protein diet, raising the phosphorus from 0.28 to 0.45 per cent increased gains 24 per cent. On a 14 per cent diet, gains were increased by 29 per cent. Phosphorus levels above 0.45 per cent did not affect growth on either protein level.

Chapman et al. (1955) reported in a comparison of colloidal clay with steamed bonemeal and dicalcium phosphate a significant decrease in rate of gain, feed efficiency and breaking strength of femurs. These were accompanied by a significant increase in ash content and an increase in the fluorine content of the femurs. The source of phosphorus supplementation did not significantly affect the phosphorus content of bone ash or the blood serum.

Further results in the comparison of colloidal clay with steamed bonemeal and dicalcium phosphate indicated that growing-finishing swine have a poorer feed efficiency and decreased average daily feed intake on

organic phosphorus sources in contrast to inorganic phosphorus sources. As the per cent of phosphorus from plant sources was decreased and the inorganic phosphorus was increased, a significant linear increase in both average daily gains and feed efficiency was noted.

Plumlee et al. (1958) in a series of experiments compared dicalcium phosphate, monocalcium phosphate, phosphoric acid, steamed bonemeal, defluorinated phosphate, Curacao Island phosphate and soft phosphate with colloidal clay to determine the availability of phosphorus from these sources to growing swine. Their results indicated that the phosphorus sources would be ranked in order of availability to growing swine as they are listed above. In Experiment I, a comparison of dicalcium phosphate and "soft phosphate" revealed that a 0.30 per cent dietary level of either source was insufficient for maximum daily gain and feed efficiency. The "soft phosphate" fed pigs showed signs of weak pasterns, flabby hams and crooked legs at levels of 0.30 and 0.60 per cent dietary phosphorus. Experiment II in a comparison of all phosphorus supplements at 0.30 per cent level showed the need for a higher per cent of phosphorus in the rations as evidenced by weak pasterns and flabby hams. Experiments I and II showed the need for a basal ration lower in phosphorus, so the ration for Experiment III was adjusted to obtain a greater per cent of the phosphorus through the use

of phosphorus supplements. This adjustment allowed a more critical evaluation of the supplements at a minimum adequate phosphorus level (0.30 per cent). Deficiency symptoms began to appear earlier in all lots with "soft phosphate" fed pigs showing the effects first. Feed efficiency and rate of gain for "soft phosphate" fed pigs was much poorer than for all other phosphorus supplements. Experiment IV indicated clearly that Curacao Island phosphate was very little better than "soft phosphate" as a source of phosphorus for growing swine. Semi-purified and corn soybean oil meal diets with phosphoric acid and dicalcium phosphate supplements were compared in Experiments V and VI. The diets containing phosphoric acid appeared to be more palatable than those containing dicalcium phosphate as evidenced by a significant increase in feed consumption during the first two weeks of the experiment.

Plumlee et al. (1958) in summarizing the experiments indicate that there is considerable variation in blood serum phosphorus, but serum phosphorus levels rose as diet levels of all supplements were increased with "soft phosphate" showing the least consistent increase in serum phosphorus.

Gobble et al. (1956) reported that the phosphorus of soft phosphate is utilized by the pig. In a comparison of dicalcium phosphate and soft phosphate at varying levels, there was no significant difference in the rate of gain for

growing-finishing swine; however, a higher bone fluorine content was noted in the soft phosphate fed pigs. No harmful effects from the increased fluorine content of the bones were observed.

In another experiment pigs were used from sows that had been fed on rations similar to the above. This procedure was designed to determine whether there would be any carry-over effect with respect to fluorine from the rations fed to the sows. The results indicated that there was no significant carry-over effect in the second generation resulting from the feeding of soft phosphate.

McDonald (1958) reported no significant differences in rate of gain, feed consumption and feed efficiency between pasture and drylot feeding using low levels (0.35 per cent) of dicalcium phosphate, defluorinated rock phosphate and Curacao Island phosphate.

Results of many experiments indicate that the biological value of phosphorus sources may vary greatly. Miller and Joukovsky (1953) compared several phosphate supplements as to effect on weight, bone ash and mortality of chicks at five weeks of age. They fed dicalcium phosphate, Curacao Island phosphate, bonemeal and defluorinated rock phosphate at two different levels. They concluded that all of the above listed supplements were good sources of readily available inorganic phosphate. Wilcox et al. (1954) reported a

wide range of variability from feeding different phosphate supplements in the performance of turkey poults. Their work indicated that dicalcium phosphate and monocalcium phosphate were more available to turkey poults than equal levels of colloidal phosphates.

Menzies et al. (1955) ran a comparison of the availability of phosphorus from phosphoric acid in comparison to steamed bonemeal for beef heifers. He concluded that the phosphorus of phosphoric acid was as available to heifers as the phosphorus in steamed bonemeal.

The literature agrees that the basal ration must be kept low in phosphorus to support a critical test for various levels and sources of phosphate supplements.

CHAPTER III

EXPERIMENTAL PROCEDURE

Sixty-four Duroc and Hampshire weanling pigs were allotted to sixteen lots on the basis of weight, breed and sex. There were four pigs per lot. Two lots were randomly assigned to each of the following treatments.

1. Control ration plus wet process acid dicalcium phosphate to furnish 0.29 per cent phosphorus from an average weight of 54.3 to 151.7 pounds and 0.35 per cent phosphorus from an average weight of 151.7 to 173.0 pounds.

2. Control ration plus electric furnace acid dicalcium phosphate to furnish 0.29 per cent phosphorus from an average weight of 54.3 to 151.7 pounds and 0.35 per cent phosphorus from an average weight of 151.7 to 173.0 pounds.

3. Control ration plus defluorinated rock phosphate to furnish 0.29 per cent phosphorus from an average weight of 54.3 to 151.7 pounds and 0.35 per cent phosphorus from an average weight of 151.7 to 173.0 pounds.

4. Control ration plus Curacao Island phosphate to furnish 0.29 per cent phosphorus from an average weight of 54.3 to 151.7 pounds and 0.35 per cent phosphorus from an average weight of 151.7 to 173.0 pounds.

5. Control ration plus wet process acid dicalcium

phosphate to furnish 0.29 per cent phosphorus from an average weight of 54.3 to 151.7 pounds and 0.70 per cent phosphorus from an average weight of 151.7 to 173.0 pounds.

6. Control ration plus electric furnace acid di-calcium phosphate to furnish 0.29 per cent phosphorus from an average weight of 54.3 to 151.7 pounds and 0.70 per cent phosphorus from an average weight of 151.7 to 173.0 pounds.

7. Control ration plus defluorinated rock phosphate to furnish 0.29 per cent phosphorus from an average weight of 54.3 to 151.7 pounds and 0.70 per cent phosphorus from an average weight of 151.7 to 173.0 pounds.

8. Control ration plus Curacao Island phosphate to furnish 0.29 per cent phosphorus from an average weight of 54.3 to 151.7 pounds and 0.70 per cent phosphorus from an average weight of 151.7 to 173.0 pounds.

The phosphorus supplements were analyzed for calcium and phosphorus per cent and were added to the control ration on the basis of these analyses. Calcium carbonate (40 per cent) and ground limestone that contained no phosphorus were used as calcium sources to standardize the calcium phosphorus ratio. One control ration was mixed for the entire experiment and was analyzed for calcium and phosphorus content. The protein content of the basal ration was adjusted as the pigs grew (54.3 to 125 pounds 16 per cent, 125 pounds to completion 14 per cent). The composi-

tion of the control ration is presented in Table I. The composition of the phosphorus supplements is presented in Table II.

The pigs were wormed at the beginning of the experiment using sodium fluoride (NaF) mixed with the feed. They were sprayed for lice at the beginning of the experiment with a solution of four pounds of DDT in fifty gallons of water.

All feed was weighed and recorded at two-week intervals to correspond with pig weigh dates at two-week intervals. Each lot was a five foot by twenty foot concrete floored, partially covered pen. Pigs were self-fed and water was available at all times.

Average daily gain, daily feed consumption and feed efficiency were the criteria used to evaluate the availability of the phosphorus supplements.

All data in the experiment were analyzed statistically by analysis of variance as outlined by Snedecor (1946).

TABLE I

COMPOSITION OF CONTROL RATIONS

Ingredient	Ration 1 per cent	Ration 2 per cent
No. 2 yellow corn	83.75	88.36
Soybean oil meal (44 per cent)	9.97	6.91
Feather meal	4.98	3.45
Trace mineral salt	1.00	0.99
B vitamin supplement ^a	0.10	0.10
Antibiotic premix ^b	0.08	0.07
B ₁₂ supplement ^c	0.06	0.06
D-L methionine ^d	0.05	0.05
Vitamin A supplement ^e	0.01	0.01
Total	100.00	100.00
Protein	16.00	14.00
Calcium in control ration	0.20	0.20
Phosphorus in control ration	0.23	0.23

^aContains 2 gm. riboflavin, 4 gm. pantothenic acid, 9 gm. niacin, 10 gm. choline chloride per lb.

^bContains 10 gm. terramycin per lb.

^cContains 9 mg. vitamin B₁₂ per lb.

^dContains 98 per cent D-L methionine.

^eContains 4,540,000 U.S.P. units per lb.

TABLE II
COMPOSITION OF PHOSPHORUS SUPPLEMENTS^a

Ingredient	Per Cent Ca	Per Cent P
Wet process acid dicalcium phosphate	22.0	18.0
Electric furnace acid dicalcium phosphate	25.2	18.6
Defluorinated phosphate	33.4	19.2
Curacao Island phosphate	31.8	14.3

^aCalcium and phosphorus analyses made by Ralston
Purina Company, St. Louis 2, Missouri.

CHAPTER IV

RESULTS AND DISCUSSION

Period From Average Weight 54.3-151.7 Pounds

There was a highly significant difference between replications (Table IV) in this experiment in average daily gains during the first feeding period (average weight 54.3-151.7 pounds). At the start of the experiment the pigs in replication one weighed an average of 51.9 pounds and pigs in replication two weighed an average of 56.7 pounds. A correlation coefficient of 0.645 was obtained in comparing rate of gain to starting weight for each pig; therefore, it appeared that starting weight was a factor in this experiment.

The source of phosphorus supplements had no significant effect upon average daily gain at ($P < 0.05$) during the first period; however, the 0.29 per cent phosphorus level in all lots after 150 pounds of weight appeared to have a depressing effect on daily gain. Average daily gain ranged from a low of 1.09 pounds per day on 0.29 per cent level wet process acid dicalcium phosphate in one lot to a high of 1.67 pounds per day on 0.29 per cent defluorinated phosphate in one lot. Most of the treatments averaged below 1.50 pounds per day as shown in Table III.

McDonald (1958) found no significant differences in

TABLE III

SUMMARY OF GROWTH AND FEED DATA
AVERAGE WEIGHT 54.3-151.7 POUNDS

Treatment	Rep.	Ave. initial wt.	Ave. final wt.	Ave. daily gain	Ave. daily feed	Feed per lb. gain
1	1	49.7	126.2	1.09	4.25	3.90
	2	<u>54.5</u>	<u>158.5</u>	<u>1.49</u>	<u>5.55</u>	<u>3.73</u>
	Average	52.1	142.3	1.29	4.90	3.81
2	1	51.0	123.8	1.04	4.39	4.22
	2	<u>56.3</u>	<u>166.0</u>	<u>1.57</u>	<u>5.52</u>	<u>3.52</u>
	Average	53.6	144.9	1.30	4.95	3.87
3	1	48.0	137.3	1.28	4.82	3.77
	2	<u>62.0</u>	<u>179.0</u>	<u>1.67</u>	<u>6.29</u>	<u>3.77</u>
	Average	55.0	158.1	1.47	5.55	3.77
4	1	54.3	146.0	1.31	4.66	3.56
	2	<u>53.0</u>	<u>156.5</u>	<u>1.48</u>	<u>5.19</u>	<u>3.51</u>
	Average	53.6	151.2	1.29	4.92	3.53
5	1	46.5	141.3	1.35	4.90	3.63
	2	<u>49.0</u>	<u>151.0</u>	<u>1.46</u>	<u>5.09</u>	<u>3.49</u>
	Average	47.7	146.1	1.40	4.99	3.56
6	1	52.8	149.8	1.39	5.43	3.91
	2	<u>59.3</u>	<u>170.3</u>	<u>1.59</u>	<u>5.66</u>	<u>3.56</u>
	Average	56.1	160.0	1.49	5.54	3.73
7	1	53.5	144.0	1.29	4.90	3.80
	2	<u>60.5</u>	<u>173.5</u>	<u>1.61</u>	<u>5.87</u>	<u>3.65</u>
	Average	57.0	158.7	1.45	5.38	3.72
8	1	59.6	152.7	1.33	5.00	3.76
	2	<u>59.5</u>	<u>152.5</u>	<u>1.33</u>	<u>4.88</u>	<u>3.67</u>
	Average	59.6	152.6	1.33	4.94	3.71
Average Rep. 1		51.9	140.1	1.26	4.79	3.82
Average Rep. 2		56.7	163.4	1.52	5.50	3.61

TABLE IV

ANALYSIS OF VARIANCE OF AVERAGE DAILY GAINS, FEED
EFFICIENCY AND AVERAGE DAILY FEED INTAKE
AVERAGE WEIGHT 54.3-151.7 POUNDS

Source	d.f.	Mean Squares		
		Ave. daily gain	Feed efficiency	Ave. daily feed intake
Replications	1	.285**	.76*	2.030*
Levels	1	.010	.016	.070
Sources	3	.010	.024	.267
Levels x Sources	3	.015	.033	.106
Error	7	.014	.028	.170

**Significant at 1 per cent level of probability.

*Significant at 5 per cent level of probability.

average daily gains from three phosphorus sources; wet process acid dicalcium phosphate, defluorinated rock phosphate and Curacao Island phosphate at ($P < 0.05$). This current work is in agreement with his report.

A significant difference was noted between replications in feed required per pound of gain and average daily feed intake during the first feeding period. The faster gaining lots were more efficient in feed utilization and had a higher average daily feed intake throughout the feeding period. The data on average daily gain, feed efficiency and average daily feed intake is given in Table III.

The phosphorus source had no significant effect on feed efficiency or average daily feed intake at ($P < 0.05$), although some source differences were observed. The pigs fed defluorinated rock phosphate had the highest average daily feed intake.

Palatability of the defluorinated rock phosphate may be a factor in the higher daily consumption of feed during the feeding period (average weight 54.3-151.7 pounds).

About the eighth week, several of the heavier, faster growing pigs in all treatments began to show signs of weak pasterns and crooked legs. Generally, the animals which ate the most feed and gained at the fastest rate developed the leg skeletal abnormalities. This is in agreement with

Plumlee et al. (1958). The pigs affected by bone abnormalities did not show a decreased rate of gain nor were there any extreme cases of bone abnormalities.

Period From Average Weight 151.7-173.0 Pounds

This part of the experiment was too short to draw definite conclusions; however, several indications are noted here that may be of help in planning further research on phosphorus feeding studies with swine.

In this part of the experiment there was a significant difference between replications (Table VI) in average daily gains. Replication one had an average daily gain of 1.41 pounds compared to 1.62 pounds for replication two (Table V). In addition, replication two still maintained a weight advantage during the final feeding period.

There was a significant difference ($P < 0.01$) in average daily gain between lots fed 0.70 per cent phosphorus and the lots fed 0.35 per cent phosphorus (Tables V and VI). There was also a highly significant difference between the 0.70 per cent and 0.35 per cent phosphorus levels in feed efficiency. All of the lots on the 0.70 per cent phosphorus level required less than four pounds of feed per pound of gain, whereas, the 0.35 per cent phosphorus level lots required four pounds or more of feed per pound of gain during this final feeding period.

The source of phosphorus had no significant effect

TABLE V

SUMMARY OF GROWTH AND FEED DATA
AVERAGE WEIGHT 151.7-173.0 POUNDS

Treatment	Rep.	Ave. initial wt.	Ave. final wt.	Ave. daily gain	Ave. daily feed	Feed per lb. gain
1	1	126.2	143.2	1.21	5.22	4.32
	2	158.5	175.5	1.21	6.77	5.60
	Average	142.3	159.8	1.21	6.00	4.96
2	1	123.8	137.8	1.00	5.71	5.71
	2	166.0	184.5	1.32	6.09	4.62
	Average	144.9	161.1	1.16	5.90	5.16
3	1	137.3	153.3	1.14	5.98	5.25
	2	179.0	200.3	1.52	6.49	4.27
	Average	158.1	176.8	1.33	6.23	4.76
4	1	146.0	164.8	1.34	6.23	4.65
	2	156.5	178.3	1.55	6.35	4.10
	Average	151.2	171.5	1.44	6.29	4.37
5	1	141.3	166.3	1.79	6.10	3.41
	2	151.0	172.8	1.55	5.61	3.62
	Average	146.1	169.5	1.67	5.85	3.51
6	1	149.8	174.0	1.73	6.88	3.98
	2	170.3	195.8	1.82	6.73	3.70
	Average	160.0	184.6	1.77	6.81	3.84
7	1	144.0	166.8	1.63	6.22	3.82
	2	173.5	202.0	2.04	6.87	3.37
	Average	158.7	184.4	1.83	6.54	3.59
8	1	152.7	172.7	1.43	5.26	3.68
	2	152.5	180.3	1.98	6.41	3.24
	Average	152.6	176.5	1.71	5.83	3.46
Average Rep. 1		140.1	160.0	1.41	5.95	4.35
Average Rep. 2		163.4	186.1	1.62	6.41	4.06

TABLE VI

ANALYSIS OF VARIANCE OF AVERAGE DAILY GAINS, FEED
EFFICIENCY AND AVERAGE DAILY FEED INTAKE
AVERAGE WEIGHT 151.7-173.0 POUNDS

Source	d.f.	Mean Squares		
		Ave. daily gain	Feed efficiency	Ave. daily feed intake
Replications	1	.185*	.330	.865
Levels	1	.846**	5.880**	.096
Sources	3	.021	.230	.204
Levels x Sources	3	.022	.053	.349
Error	7	.033	.282	.221

**Significant at 1 per cent level of probability.

*Significant at 5 per cent level of probability.

on feed efficiency, average daily gain or average daily feed intake at ($P < 0.05$).

There were no significant differences between replications or levels in average daily feed intake. The mean squares of the replications were approaching significance at ($P < 0.05$).

The results of this study emphasize the fact that in order to critically evaluate phosphorus supplements for swine, the basal rations to which the supplements are to be added should be considerably below the minimum phosphorus level. Also, enough phosphorus should be added to provide no more than the minimum adequate total phosphorus level.

Another critical factor would appear to be the starting weight of the pigs. Indications from this experiment are that lightweight pigs (forty-five pounds or less in weight) may give a more critical test of phosphorus adequacy than heavier pigs.

A level of 0.29 per cent phosphorus was inadequate for normal skeletal growth as evidenced by the fact that approximately twenty-five per cent of all animals on experiment developed some form of skeletal abnormalities, although none became serious. The final feeding period was too short to observe any differences in skeletal growth even though phosphorus levels were increased.

Total Feeding Period Average Weight 54.3-173.0 Pounds

There was a highly significant difference between replications for average daily gain and average daily feed intake (Tables VII and VIII) for the total feeding period. Replication one had an average daily gain of 1.29 pounds compared to 1.54 pounds for replication two. In addition, replication one had an average daily feed intake of 4.99 pounds while replication two had an average daily feed intake of 5.66 pounds. There was also a significant difference between replications in feed efficiency. The pigs in replication two had heavier starting weights, gained faster, ate more feed per day and were more efficient in the utilization of feed than replication one during the total feeding period.

There was a significant difference between the 0.70 and 0.30 per cent levels of phosphorus for feed efficiency and there was a difference approaching significance for average daily gain.

The source of phosphorus had no significant effect ($P < 0.05$) on average daily gain, feed efficiency or average daily feed intake.

TABLE VII

SUMMARY OF GROWTH AND FEED DATA
AVERAGE WEIGHT 54.3-173.0 POUNDS

Treatment	Rep.	Ave. initial wt.	Ave. final wt.	Ave. daily gain	Ave. daily feed	Feed per lb. gain
1	1	49.7	143.2	1.11	4.43	3.98
	2	<u>54.5</u>	<u>175.5</u>	<u>1.44</u>	<u>5.75</u>	<u>3.99</u>
	Average	52.1	159.8	1.27	5.09	3.98
2	1	51.0	137.8	1.03	4.61	4.47
	2	<u>56.3</u>	<u>184.5</u>	<u>1.53</u>	<u>5.62</u>	<u>3.68</u>
	Average	53.6	161.1	1.28	5.11	4.07
3	1	48.0	153.3	1.25	5.00	3.99
	2	<u>62.0</u>	<u>200.3</u>	<u>1.65</u>	<u>6.34</u>	<u>3.85</u>
	Average	55.0	176.8	1.45	5.67	3.92
4	1	54.3	164.8	1.32	4.92	3.74
	2	<u>53.0</u>	<u>178.3</u>	<u>1.49</u>	<u>5.38</u>	<u>3.61</u>
	Average	53.6	171.5	1.40	5.15	3.67
5	1	46.5	166.3	1.43	5.11	3.59
	2	<u>49.0</u>	<u>172.8</u>	<u>1.47</u>	<u>5.17</u>	<u>3.51</u>
	Average	47.7	169.5	1.45	5.14	3.55
6	1	52.8	174.0	1.44	5.67	3.92
	2	<u>59.3</u>	<u>195.8</u>	<u>1.63</u>	<u>5.83</u>	<u>3.59</u>
	Average	56.1	184.6	1.53	5.75	3.75
7	1	53.5	166.8	1.35	5.13	3.81
	2	<u>60.5</u>	<u>202.0</u>	<u>1.68</u>	<u>6.06</u>	<u>3.60</u>
	Average	57.0	184.4	1.51	5.59	3.70
8	1	59.6	172.7	1.35	5.04	3.75
	2	<u>59.5</u>	<u>180.3</u>	<u>1.44</u>	<u>5.14</u>	<u>3.58</u>
	Average	59.6	176.5	1.38	5.09	3.66
Average Rep. 1		51.9	160.0	1.29	4.99	3.91
Average Rep. 2		56.7	186.1	1.54	5.66	3.67

TABLE VIII

ANALYSIS OF VARIANCE OF AVERAGE DAILY GAINS, FEED
EFFICIENCY AND AVERAGE DAILY FEED INTAKE
AVERAGE WEIGHT 54.3-173.0 POUNDS

Source	d.f.	Mean Squares		
		Ave. daily gain	Feed efficiency	Ave. daily feed intake
Replications	1	.262**	.211*	1.809**
Levels	1	.058	.240*	.075
Sources	3	.010	.041	.256
Levels x Sources	3	.014	.033	.113
Error	7	.013	.031	.147

**Significant at 1 per cent level of probability.

*Significant at 5 per cent level of probability.

CHAPTER V

SUMMARY

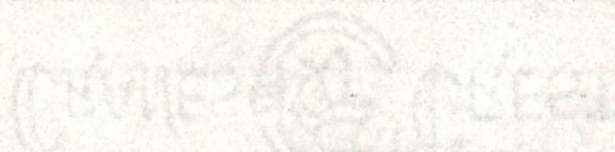
Sixty-four Hampshire and Duroc weanling pigs were allotted to sixteen lots of four pigs each and fed in concrete pens from an average weight of 54.3 pounds to an average weight of 173.0 pounds. Eight treatments were used with two replications per treatment.

There was a highly significant difference between replications for average daily gain and average daily feed intake for the total feeding period. There was also a significant difference between replications for feed efficiency during the total period. A comparison of levels of dietary phosphorus resulted in a significant difference for feed efficiency. At the start of the experiment, pigs in replication one weighed an average of 51.9 pounds and pigs in replication two weighed an average of 56.7 pounds. At the completion of the experiment, pigs in replication one weighed an average of 160.0 pounds and pigs in replication two weighed an average of 186.1 pounds.

There were significant differences between replications in average daily gain, feed efficiency and average daily feed intake for part one of the feeding period (average weight 54.3-151.7 pounds). No differences among sources or levels were noted in this part of the experiment.

In part two of the feeding period (average weight 151.7-173.0 pounds), highly significant differences were noted between levels of dietary phosphorus for average daily gain and feed efficiency. There was also a significant difference between replications in average daily gain during the final feeding period.

There were no significant differences in any of the criteria due to sources of phosphorus supplementation. The low phosphorus level appeared to have a depressing effect on average daily gain in all lots and pigs in all treatments were observed to show signs of weak pasterns and crooked legs. ✓



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