

## A Preliminary Report for Growing-Finishing Rations . . .

# Phosphorus Additions to Barley-Soy Rations

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Phosphorus is a member of one of the most complex series of interrelationships in nutrition. The obvious members of these interrelationships are calcium and vitamin D, but they also include most of the trace minerals as well as some members of the B-vitamin complex. The critical item in phosphorus nutrition is the level of available phosphorus and not the total level of phosphorus in the ration. The grain portion contributes much of the total phosphorus in any ration. The higher availability of phosphorus from barley than from corn suggests that the total level of phosphorus might be reduced in rations for growing-finishing swine without detrimental effect.

Phosphorus became a critical factor in animal nutrition during the recent energy crisis. The price of phosphorus skyrocketed as the availability of acceptable forms of phosphorus plummeted. National groups of animal nutritionists hurriedly met to determine the minimum phosphorus levels that could be acceptable for short periods of time. The price of meat and bone meal, etc., increased dramatically and maximum levels of low-quality phosphorus sources (which contain appreciable levels of fluorine) were reviewed.

The national nutrition councils correctly distinguished between minimum levels of phosphorus for market hogs and for replacement gilts and other breeding stock (replacement gilts and lactating sows would be expected to require a higher level of phosphorus than would market animals). The experiments reported here were part of a cooperative study sponsored by the North Central Committee on Swine Nutrition (NCR-42), and were designed to yield information relative to the minimum level of added phosphorus in rations intended for market swine.

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### Experimental Procedure

Forty-eight pigs having an average initial weight of 49 pounds were assigned to pens (containing 6 pigs each) on the basis of breed, sex, litter and weight. Two rations, differing only in the amount of added phosphorus, were formulated for this initial experiment. One ration contained 0.1 per cent added phosphorus while the second contained 0.2 per cent added phosphorus. The barley and soybean meal utilized in the experiment contributed 0.4 per cent phosphorus to the final ration, resulting in rations containing 0.5 and 0.6 per cent total phosphorus. The gross phosphorus level recommended for growing-finishing swine is 0.5 per cent of the ration.

Components of these rations were ground and fed to weanling male rats having an average initial weight of 75 grams (there were 10 male rats per treatment). The object of the rat trial was to conduct a digestibility trial and to obtain information to supplement that obtained in the first swine experiment.

The second growing-finishing experiment with swine utilized 42 pigs having an average initial weight of 48 pounds. Allotment to pens was again based upon breed, sex, litter and weight. Six pens contained five pigs each and two pens contained six pigs each. The two rations formulated for this experiment contained 0.0 per cent or 0.1 per cent added phosphorus for levels of 0.4 per cent or 0.5 per cent total phosphorus.

The amount of limestone added to all experimental rations was varied to maintain similar calcium-to-phosphorus ratios (approximately 1.2:1).

### Results and Discussion

Diet did not significantly influence rate of gain in Experiment 1, and level of dietary phosphorus also had no effect upon average daily feed consumption or feed required per unit of weight gain (see Table 1). A similar lack of effect of level of dietary phosphorus was noted when these diets were fed to growing rats (Table 2). In addition to the lack of effect upon performance criteria, there were no differences in the digestibility of the ration nor the total level of phosphorus apparently digested and absorbed by the growing rats.

**Table 1. Results of Phosphorus Experiment No. 1**

Item:	Added phos:	0.1%	0.2%
	Total phos:	0.5%	0.6%
No. of Pigs	24	24	
Av. initial wt.	49.3	49.4	
Av. daily gain	1.55	1.61	
Av. daily feed	5.75	5.81	
F/G	3.71	3.62	

In an additional facet of this experiment, all gilts receiving the two levels of phosphorus in the first experiment were retained for breeding. The herdsmen noted that the gilts receiving the higher level of phosphorus (0.6 per cent) were extremely difficult to manage during estrus. Specifically, the gilts receiving 0.6 per cent total phosphorus did not readily accept the boar and were extremely excitable in the presence of the boar.

To further evaluate the effect of dietary phosphorus levels, the gilts from the experiment were maintained on their respective dietary treatments through the farrowing period. The negative effects of the higher level of phosphorus continued during this period. The gilts which had received

**Table 2. Results of Phosphorus Experiment with Rats<sup>1</sup>**

Item:	Added phos:	0.1%	0.2%
	Total phos:	0.5%	0.6%
No. of rats	10	10	
Av. initial wt.	75.2	75.3	
Av. daily gain	6.3	6.3	
Av. daily feed	19.52	20.43	
F/G	3.08	3.25	
DE <sup>2</sup> of ration, Kcal/gram	3.006	3.034	
Digest. phosphorous, %	0.257	0.262	
Digestible Protein, %	12.28	12.23	

<sup>1</sup>Rations were those utilized in the first swine experiment. All weights are in grams.

<sup>2</sup>DE = Digestible energy.

0.6 per cent phosphorus had difficulty farrowing, farrowed extremely small pigs and did not milk normally after farrowing. The gilts frequently required oxytocin to release their milk. These results indicate that recommended levels of phosphorus result in normal reproductive performance in gilts, while excess phosphorus was extremely detrimental to normal reproduction and lactation despite the fact that a constant ratio of calcium to phosphorus was maintained.

The results of the second swine experiment (Table 3) demonstrate that growing-finishing swine **receiving well-balanced barley-soy rations** may not require sources of supplemental phosphorus for normal performance. This does not suggest nor imply that replacement breeding stock should not receive normal levels of phosphorus (0.5 per cent total phosphorus) which require the addition of supplemental phosphorus. Feeding low levels of phosphorus could result in poor reproductive performance, poor milking ability, and a potential increase in "downer" sows. ("Downer" sows are those that exhibit posterior paralysis, frequently due to a broken femur or hip, during the lactation period.)

**Table 3. Results of Phosphorus Experiment No. 2**

Item:	Added phos:	0.0%	0.1%
	Total phos:	0.4%	0.5%
No. of pigs	21	21	
Av. initial wt. lb.	47.9	47.7	
Av. daily gain, lb.	1.54	1.59	
Av. daily feed, lb.	4.97	5.09	
F/G	3.22	3.21	

### Summary

Two experiments involving a total of 90 pigs and a trial utilizing 20 rats were conducted to evaluate the effect of phosphorus additions to barley-soy rations for growing-finishing swine.

The addition of phosphorus to the growing-finishing swine rations did not improve performance criteria (rate of gain or feed required per unit of gain). Excess phosphorus was extremely detrimental to reproductive performance when fed from approximately 50 pounds through the lactation period. Conversely, inadequate phosphorus would be expected to have negative effects upon reproduction performance.

North Dakota swine producers must use sound judgement in selecting phosphorus levels for their growing-finishing swine. Any animal considered to be potential breeding stock should receive the recommended level of dietary phosphorus at 0.5 per cent of the ration.