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T L. Weeden

J A. Hansen

K G. Friesen

See next page for additional authors

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Authors

T L. Weeden, J A. Hansen, K G. Friesen, B T. Richert, Jim L. Nelssen, and Robert D. Goodband

EFFECTS OF THE INTERRELATIONSHIP OF PORCINE SOMATOTROPIN ADMINISTRATION AND DIETARY PHOSPHORUS ON GROWTH PERFORMANCE IN DEVELOPING GILTS[1]

T. L. Weeden, J. L. Nelssen, R. D. Goodband, J. A. Hansen, K. G. Friesen, and B. T. Richert

Summary

Seventy-two gilts (initial weight = 127 lb) were used to determine effects of the interrelationship of porcine somatotropin (pST) administration and dietary phosphorus (P) on growth performance of finishing gilts (127 to 235 lb) and for a 35 d postfinishing phase following withdrawal of pST administration. Gilts were injected daily with placebo (control) or 4 mg pST and fed .4, .6, or .8% P in the finishing phase. Administration of pST increased average daily gain (ADG), improved feed efficiency (F/G), and decreased average daily feed intake (ADFI) during the finishing phase. Increasing dietary P resulted in increased ADG from d 0 to 28 of the finishing phase; however, dietary P had no effect on ADG, F/G, or ADFI for the overall finishing phase. When each block weight averaged 235 lb, half of the gilts were slaughtered. Administration of pST decreased backfat thickness, dressing percentage, and kidney fat weight and increased longissimus muscle area and carcass length. Dietary P had no effect on carcass criteria measured. The remaining 36 gilts were individually fed 4 lb/d of a common diet to assure P intake of 22.8 g/d for the 35 d postfinishing phase. Gilts that received pST in the finishing phase had decreased ADG and poorer feed conversion in the postfinishing phase. Dietary P level in the finishing phase had no effect on postfinishing performance. From d 0 to 28 of the finishing phase, pST-treated gilts required a diet with more than .4% P (10.3 g/d P) to maximize growth performance. However, a .4% P diet (12.4 and 10.7 g/d P, control and pST-treated, respectively) is adequate for growth performance during the overall finishing phase (127 to 235 lb).

(Key Words: Somatotropin, Phosphorus, Performance, Gilts.)

Introduction

Previous research at Kansas State University has established that pST-treated pigs have higher lysine requirements than non-pST-treated pigs to maximize growth performance. Dietary percentages of calcium (Ca) and phosphorus (P) may also need to be adjusted, because pST-treated pigs require at least the same daily intakes of Ca and P as control pigs, but consume less because of reduced feed intake. Therefore, the present study was designed to determine if pST-treated gilts have higher daily requirements for Ca and P than non-pST-treated gilts for maximum growth performance.

Procedures

A total of 72 crossbred gilts (Hampshire × Chester White × Yorkshire × Duroc) with an initial average weight of 127 lb was used in a randomized complete block design with a 2 × 3 factorial arrangement. Gilts were blocked by weight, allotted by ancestry to pens, and randomly assigned to experimental treatments. There were two gilts per pen and six replications per treatment. Gilts

[1]The authors would like to thank Pitman-Moore, Inc. for providing the pST used in this experiment.

were housed in 5 ft × 5 ft pens in an environmentally controlled building with total concrete slatted flooring. They were given ad libitum access to feed and water.

Experimental treatments consisted of daily injections of placebo or 4 mg pST and a corn-soybean meal diet (1.2% lysine; Table 1) containing either .4, .6, or .8% P. These correspond to 100, 150, and 200% of NRC (1988) estimates for P in finishing diets (110 to 240 lb). Dietary P levels were attained by replacing corn with monocalcium P and limestone. A constant Ca:P ratio of 1.25:1 was maintained throughout the entire experiment. All other nutrients were formulated to be at least 200% of NRC (1988) estimates for finishing pigs. When the mean weight of gilts in a block reached 235 lb, daily injections were terminated and one gilt per pen was slaughtered. Following slaughter, standard carcass measurements were recorded.

The remaining 36 gilts (six per treatment) were mixed and placed 18 per 150 ft × 100 ft pen in dirt lots, but without direct contact with boars. Gilts were individually fed 4 lb/d of a common diet (Table 1) to ensure daily intakes of 22.8 g of P. This corresponds to 200% of the NRC (1988) recommended daily intake for P in developing gilts. An additional 1.5 lb/d of corn was offered to all gilts that consumed the initial 4 lb feeding to ensure adequate energy intake to tolerate cold stress in the outdoor lots. On d 35, all gilts were weighed to determine live weight gain and feed/gain and then slaughtered. Carcass data were collected as described for the finishing phase. Reproductive tracts were also collected and evaluated to determine if gilts had reached puberty and exhibited estrus.

Results and Discussion

No pST × P interactions ($P>.15$) were observed for any of the growth response criteria measured (Table 2). Gilts administered pST exhibited increased ($P<.01$) ADG, improved feed/gain (F/G) and reduced ($P<.01$) feed intake from d 0 to 28 and for the overall finishing phase. From d 0 to 28, ADG responded (quadratic, $P<.04$) to increasing dietary P, with the highest ADG being achieved on the .6% P diet regardless of whether gilts received pST or not. However, dietary P had no effect ($P>.23$) on ADG, F/G, or average daily feed intake (ADFI) for the overall finishing phase.

Gilts administered pST had decreased ($P<.03$) dressing percentage, backfat thickness, and kidney fat weight (Table 3). Administration of pST also increased ($P<.01$) longissimus muscle area and carcass length. Dietary P had no effect ($P>.13$) on carcass traits.

Gilts that were administered pST in the finishing phase had decreased ($P<.01$) ADG and poorer feed conversions following withdrawal of pST injections during the 35-d postfinishing phase (Table 4). Dietary P level received during the finishing phase had no effect ($P>.23$) on postfinishing performance. Percentages of gilts attaining puberty and exhibiting estrus by the end of the postfinishing phase were not affected ($P>.32$) by pST-treatment or dietary P level fed in the finishing phase.

Following the 35 d postfinishing phase, gilts that received pST in the finishing phase had decreased ($P<.02$) backfat and kidney fat and increased ($P<.02$) carcass length (Table 3). Carcass weight was also decreased ($P<.02$) for gilts that received pST in the finishing phase because of decreased growth during the postfinishing phase. Dietary P level received in the finishing phase had no effect ($P>.10$) on postfinishing carcass measurements with the exception of dressing percentage, which tended (quadratic, $P<.08$) to be slightly lower for gilts that received the .6% P diet during the finishing phase.

Our results support previous findings in that 98% of maximum ADG and feed efficiency were achieved at 99.8% of NRC

(1988) estimates for P intake in non-pST-treated pigs. In a previous experiment at Kansas State University, growth of finishing gilts was not maximized in either control or pST-treated gilts, when daily P intakes were 82 and 78%, respectively, of NRC (1988) estimates (12.4 g/d P) for finishing pigs. Researchers at Kentucky suggested that dietary percentages of P may need to be increased because of decreased feed intake. Therefore, the major obstacle in formulating diets to meet the requirement of P for growth in pST-treated pigs is determining how much their feed intake will be reduced. The reduction in feed intake when pigs are administered pST is highly variable, ranging from 4 to 32%. When energy is limiting, protein accretion is slowed; thus, energy density of the diets would also need to be increased in order to maximize growth performance when feed intake is reduced by substantial amounts.

Fewer gilts had reached puberty by the end of the postfinishing phase in this experiment compared to our previous study, although no differences were due to treatments received during the finishing phase. The reduced number of gilts reaching puberty in this experiment may be attributed to their slower adaptation to being housed outdoors than gilts in the previous experiment, because these gilts did not consume their entire daily feed allotments until the third week. To attain normal reproductive function, pST treatment must be withdrawn at the end of the finishing period, because continued pST-treatment results in inhibition of puberty.

In conclusion, the NRC (1988) requirement estimates of .5% Ca and .4% P (15.5 g/d Ca, 12.4 g/d P) appear adequate in meeting the needs of control and pST-treated pigs for maximum growth performance during the finishing phase. Also gilts administered pST during the finishing phase should have reproductive performance comparable to that of non-pST-treated gilts, if pST treatment is terminated at the end of the finishing phase.

Table 1. Composition of Diets

	Finishing phase[a]	Postfinishing[b]
Ingredient, %	.4% P	1.2% P
Corn	62.98	78.69
Soybean meal (48% CP)	29.77	14.53
Soybean oil	5.00	—
L-lysine HCl	.16	—
Monocalcium phosphate	.16	4.22
Limestone	.78	1.66
Salt	.30	.50
Vitamin premix	.50	.25
Trace mineral premix	.20	.10
Selenium premix	.05	.05
Antibiotic[c]	.10	—
Total	100.00	100.00
Calculated analyses, %		
Lysine	1.20	.65
Ca	.50	1.50

[a]Monocalcium phosphate and limestone were added in place of corn to provide P levels of .6 and .8% finishing diets were fed from 127 to 235 lb.
[b]Postfinishing, fed for 35 d following the finishing phase.
[c]Provided 10 mg chlortetracycline per lb of complete diet.

Table 2. Effect of Porcine Somatotropin and Dietary Phosphorus on Growth Performance of Gilts from 127 to 235 Pounds[a]

	Placebo			4 mg pST			
Item	.4% P	.6% P	.8% P	.4% P	.6% P	.8% P	SE
Initial wt, lb	127.6	127.7	127.8	127.6	127.6	12.6	2.64
ADG, lb							
0 to 28 d[bc]	2.36	2.43	2.29	2.42	2.76	2.66	.08
Overall[b]	2.21	2.22	2.15	2.36	2.49	2.47	.07
ADFI, lb							
0 to 28 d[b]	6.62	7.05	6.72	5.67	5.96	5.74	.27
Overall[b]	6.86	7.24	6.96	5.88	6.04	5.87	.23
Feed/gain							
0 to 28 d[b]	2.82	2.92	2.93	2.35	2.16	2.17	.09
Overall[b]	3.13	3.27	3.26	2.50	2.43	2.40	.10
Phosphorus intake, g/d							
0 to 28 d[bd]	12.0	19.2	24.4	10.3	16.2	20.8	.77
Overall[bd]	12.4	19.7	25.3	10.7	16.5	21.3	.64
Calcium intake, g/d							
0 to 28[bd]	15.0	24.0	30.5	12.9	20.3	26.0	.97
Overall[bd]	15.6	24.6	31.6	13.3	20.6	26.7	.81

[a]Values are least squares means, data were collected from a total of 72 gilts, two gilts per pen, six pens per treatment.
[b]Effect of pST ($P < .01$).
[c]Effect of P (quadratic, $P < .04$).
[d]Effect of P (linear, $P < .01$).

Table 3. Effect of Porcine Somatotropin and Dietary Phosphorus on Carcass Measurements[a]

Item	Placebo			4 mg pST			SE
	.4% P	.6% P	.8% P	.4% P	.6% P	.8% P	
Finishing phase[b]							
Live wt, lb[f]	236.1	236.6	233.0	243.1	249.5	248.6	5.14
Hot carcass wt, lb	177.2	176.8	169.9	171.7	181.7	179.2	4.36
Chilled carcass wt, lb	174.2	173.3	166.7	168.4	177.7	175.7	4.32
Dressing percentage[g]	73.9	73.7	73.6	73.1	71.8	71.3	.79
Average backfat thickness, in[c,e,g]	1.33	1.33	1.33	1.01	.93	.99	.06
Longissimus muscle area, in^{2}[e,g]	5.54	5.43	5.66	6.61	6.95	6.23	.33
Carcass length, in[e,g]	30.94	31.01	31.11	31.17	32.29	31.75	.26
Kidney fat, g[e,g]	1,739	1,792	1,677	1,082	806	984	137
Postfinishing phase[d]							
Hot carcass wt, lb[g]	192.1	194.4	196.2	185.4	180.1	177.3	5.9
Chilled carcass wt, lb[g]	187.4	188.3	191.5	180.8	175.4	173.1	5.7
Dressing percentage[h]	72.8	70.9	71.9	70.1	70.0	70.7	.62
Average backfat thickness, in[c,e,g]	1.22	1.19	1.21	.98	1.12	.96	.05
Longissimus muscle area, in^{2}[e]	5.65	6.22	5.80	6.41	6.11	6.06	.31
Carcass length, in[e,g]	31.93	32.19	31.77	32.54	32.51	32.61	.27
Kidney fat, g[e,g]	1,367	1,550	1,853	1,238	1,181	1,125	174

[a]Values are least squares means.
[b]Data collected from six gilts per treatment, average final weight of 235 lb.
[c]Mean of measurements taken at the first rib, the last rib, and the last lumbar vertebra.
[d]Data collected from six gilts per treatment following a 35 d period on a common diet without daily injections of pST or placebo.
[e]Values were adjusted by using live weight as a covariate.
[f]Effect of pST ($P < .07$).
[g]Effect of pST ($P < .03$).
[h]Effect of P (quadratic, $P < .10$).

Table 4. Effect of Porcine Somatotropin Administration and Dietary Phosphorus Levels during the Finishing Phase on Postfinishing Performance[ab]

Item	Placebo			4 mg pST			SE
	.4% P	.6% P	.8% P	.4% P	.6% P	.8% P	
Initial wt, lb	245.1	245.2	247.6	257.0	257.1	252.6	5.3
Final wt, lb	278.2	287.3	287.5	278.7	277.1	267.6	9.7
ADG, lb[c]	.95	1.19	1.15	.62	.57	.42	.20
Feed/gain[c]	4.55	4.35	4.76	7.69	6.25	10.0	.93
ADFI, lb	4.97	5.19	5.30	5.74	5.02	4.91	.33
Phosphorus intake, g/d	18.81	19.45	19.61	20.90	18.91	18.33	.91
Percentage exhibiting estrus	50.00	66.67	66.67	50.00	66.67	50.00	—

[a]Values are least squares means.
[b]Data collected from six gilts per treatment during a 35-d period on a common diet without daily injections of pST or placebo.
[c]Effect of pST administration in the finishing phase ($P < .01$).