North Dakota State University * Dickinson Research Extension Center
1089 State Avenue, Dickinson, ND 58601-4642 Voice: (701) 483-2348 FAX: (701) 483-2005

FEEDING MANAGEMENT STRATEGIES FOR EARLY WEANED PIGS FOLLOWING TREATMENT FOR *S. SUIS* INFECTION USING SPRAY DRIED PORCINE PLASMA AND PELLETED DIETS

D. Landblom, C. Poland, T. Winch and J. Kubik
Dickinson Research Extension Center, Dickinson, North Dakota
North Dakota State University

SUMMARY

Subsequent impact on weanling pig performance during the second and third dietary phases, following initial phase 1 exposure to a commercial pelleted starter (CS) diet or farm processed wheat/barley/dried whey based starter diets prepared with or without spray dried porcine plasma (PP), was evaluated in three experiments using 378 18-21 day old weanling pigs.

Experiment 1. No differences were measured between starter types for ADG, feed intake, and feed to gain ratio the first 7 days after weaning. In the second phase, also fed for 7 days, pigs that received control and pelleted CS during phase 1 gained faster than the PP group. When the common phase 3 diet was offered (14 days), no difference in ADG or feed efficiency were measured. For the full 28-day nursery period, no difference for ADG was recorded between treatments, but pigs started on pelleted CS consumed less feed/pound of gain ($P<.05$) compared to the control, and tended to be more efficient than the PP fed pigs. Although not significantly different, feed costs/head were $3.86, $3.96, and $4.14 for the control, PP and pelleted CS, respectively.

Experiment 2. Feeding time for the phase 2 and 3 diets were switched (phase 2 - 14 days; phase 3 - 7 days). Phase 1 ADG and feed intake for the pelleted CS and PP were similar and greater ($P<.05$) than the control, however, feed efficiencies were similar. Phase 1 feed costs were lower for the control. Subsequent performance in

phases 2 and 3 favored the pelleted CS, in which, ADG, feed intake and gain cost efficiency were better than either the control or PP supplemented starters. For the full 28-day period, gain and feed consumption were higher for the pelleted CS pigs compared to the control starter. Plasma pigs were intermediate. Pig gain for the 28-day period translated into 27.7% and 16.8% heavier pigs in the CS and PP groups. Non-significant nursery feed costs/head were \$3.66, \$4.58, and \$5.28 for the control, plasma, and pelleted CS, respectively.

Experiment 3. Phase 1 starters were fed for 14 days before being switched to phase 2 and 3 common diets for 7 days each. Average daily gain in phase 1 tended to be slightly greater for the pelleted CS, but the feed to gain ratio was significantly ($P<.05$) improved. Subsequent growth during phases 2 and 3 were very good for all starter types. Pelleted CS had faster gains ($P<.05$) , though, and consumed less daily feed in phase 2, but phase 3 consumption was higher. For the full 28-day period, the pelleted CS resulted in faster ADG, increased feed intake, improved feed efficiency, and higher cost/pound of gain ($P<.05$). Compared to the pelleted CS, the control and PP supplemented pigs were 23.2% and 26.3% lighter, respectively. Significant feed costs/head were recorded in this experiment, and were \$4.03, \$4.70 and \$6.38 for the control, PP, and pelleted CS, respectively.

Dietary phases contained progressively less dried whey. It would appear, in experiment 1, that the progression through phases 1 and 2 to phase 3 was too rapid for the immature digestive systems of young pigs in transition.

A 4% porcine plasma level was determined, going into the study, to be a practically priced level to add, but in these experiments the 4% level yielded inconsistent performance that was equal to, or slightly better than the controls, but was more costly/pound of gain.

Pig response in phase 2 appears to be a strong indicator of weaning transition success and nursery acclimitization. Following longer phase 1 and 2 feeding periods, consistently greater pig responses were preceded by the pelleted CS. Of the feeding management regimes evaluated, experiment 2 demonstrates the most desirable performance/economic balance. Preceding phases 2 and 3 with the pelleted CS gave weanling pigs, in this group of investigations, the strongest start at a reasonable price.

Pretreatment with the antibiotic amoxicillin and *S. suis* antiserum as a combination prevention method for the control of *S. suis* infection in weanling pigs was of no value with respect to animal performance. In fact, there was a trend toward poorer performance among those pigs receiving the two injections.

INTRODUCTION

Matching feeding management methods to the growth curve of young swine (18-21 days) can have a pronounced effect on post weaning growth and feeding economics. Physical form, dietary protein quality and energy are criteria that, when in proper balance, will allow pigs to grow at or near their genetic potential.

A review of the scientific literature reveals spray-dried porcine plasma and dried whey to be important ingredients for young weanling pigs. Pelleting, as well, is a beneficial processing method. Evaluated in numerous experiments, pelleting has repeatedly been shown to enhance growth performance. Factors attributed to improved performance include reduced feed waste, increased diet digestibility, improved growth rate and feed efficiency. A survey of 117 experiments revealed a 6.6% increase in growth rate and 7.9% increase in feed efficiency due to pelleting (Patience and Thacker, 1989). Greatest response to pelleting occurs when fibrous basal grains, like barley, are pelleted.

Animal protein supplements (porcine plasma, dried whey, dried skim milk, caesin, lactose/starch, porcine blood, bovine plasma and meat extract) have been evaluated in the diets of early-weaned pigs by Hansen and co-workers (1993). Of the supplement sources tested, porcine plasma (10.3%) fed in conjunction with dried whey (20%) and added lactose (10%) resulted in significantly higher average daily gain (ADG) and average daily feed intake, during the first two weeks after weaning, and for the entire 35 day post weaning period. Kats et al. (1994) investigated the effects of porcine plasma at various levels of inclusion ranging from 0 to 10%. Average daily gain and feed intake increased with increasing levels of porcine plasma, but gain to feed ratios were not affected.

Beneficial responses from dietary dried whey by young pigs has been known for some time. The trend toward earlier weaning of pigs has resulted in a greater reliance on whey in starter diets. Mahan et al. (1993) summarized the impact of dried whey and lysine inclusion in early-weaned pig diets, and concluded that good quality whey enhanced growth rates, feed intakes and gain:feed response. When .95% and 1.10% supplemental lysine was included in the corn-SBM diets formulated with and without dried whey, a positive growth response was obtained in the presence of dried whey. They concluded that lysine was not the first limiting nutrient, and predicted that the lactose component present in dried whey initiated the observed growth response. The immature digestive system of very young pigs needs a constant but gradually declining supply of lactose which is most easily supplied in starter diets using dried whey.

A common practice among hog producers is to start freshly weaned pigs on a pelleted commercial weaning ration containing high levels of dried whey followed by switching to farm processed rations after the first 7 to 14 days. Since porcine plasma and dried whey are important ingredients in the initial diets of early-weaned pigs, and pelleting has repeatedly been shown to improve performance, feeding management strategies were evaluated around nutrient dense diets containing a full compliment of dried whey and 4% spray dried porcine plasma.

Objectives in this piglet feeding management investigation included:

1. Evaluate the subsequent impact on weanling pig performance during the second and third dietary phases following initial exposure to a commercial pelleted diet and farm processed wheat/barley/dried whey based starter diets prepared with and without spray-dried porcine plasma.
2. Evaluate pig response by phase and overall performance when the length of phase feeding time varied in a three phase feeding system.
3. To evaluate the effect on piglet performance following application of a *S. suis* prevention regime that included administration of a synthetic penicillin, amoxicillin, and *S. suis* antiserum.

MATERIALS AND METHODS

Three hundred seventy-eight (378) weanling pigs (18-21 days) were randomly allotted to three dietary treatments in three triple replicated experiments of 126 pigs each.

Experiment 1

A farm processed (**FP**) wheat/barley/dried whey based control diet was compared to a similar diet containing 4% spray dried porcine plasma (**PP**), and a pelleted commercial starter (**CS**) diet also containing dried whey and spray dried porcine plasma. The farm processed diets and nutrient analysis of all diets are shown in table 1.

Pigs used in each experiment were transferred immediately after weaning, weighing and vaccination (3-way vaccine; Schering-Plough) to a confinement nursery building and allotted to experimental treatments. Seven pigs were allotted per pen, and there were three replicates per treatment. Pen served as the experimental unit. The nursery building used is a modular 12'x54' structure equipped with stainless steel pens (16 sq. ft.) and feeders, Filter-eze^{R} flooring, "pull plug" type self contained manure pits, positive ventilation and computer modulated ventilation and heat control.

Initial nursery room temperature was 85^{o}F. A computer ramping feature in the facilities environmental control system was set to lower room temperature one-half degree daily from 85^{o}F to 75^{o}F. Temperature ramping was turned off at 75^{o} F where the room temperature was kept for the remainder of the nursery study.

The pelleted **CS** diet (Vigorstart 120 C - Med) was purchased from Vigortone Ag Products' local retailer, Steffan Feeds, Dickinson, ND 58601. The **FP** diets were prepared using a New Holland 355 grinder/mixer equipped with electronic scale and 1/8" screen. Diet porosity goal was 700-800 microns. The experimental diets were weighed into each pen and self-fed. Pigs and feed were weighed at the beginning and at the end of each dietary phase change.

Experiments 2 and 3

Diets and handling procedures in the second and third experiments were the same as those in experiment 1 except the length of time each phase was fed varied. Variations in phase length are shown in table 2.

Determining whether using a preventative treatment with an antibiotic and *S. suis* antiserum would reduce the influence of *S. suis* infection on performance was accomplished by adding an additional set of replicates to each treatment in the three experiments. Each piglet assigned to the additional treatment replicates received 1cc (15mg.) of amoxicillin and 1cc of *S. suis* antiserum subcutaneously in the neck when weaned.

Pigs in all treatments were fed for four seven day periods for a total feeding period of 28 days.

All data were analyzed using the GLM procedures of SAS (1985). Average daily gain, feed/head/day, feed/pound of gain, feed cost/head/day, and feed cost/pound of gain were analyzed with diet, phase, antibiotic/ antiserum treatment, and rep as main effects. All possible interactions were tested. In all analyses, pen was the experimental unit.

RESULTS

Experiment 1

Control, plasma supplemented and pelleted commercial post-weaning starter diets were offered to 126 (14-15 pound) pigs during the first 7 days post-weaning. After an initial seven day exposure to the starter diets, the pigs were switched to a common farm processed phase 2 diet for seven days and a phase 3 diet for 14 days. Combined growth, antibiotic /antiserum treatment and piglet response to initial starter diet types and subsequent response to dietary phase changes are shown in table 3. No differences were measured between the starters for ADG, feed/head/day, and feed to gain ratio during the first seven days after weaning. Control feed cost/pound of gain was considerably less than the CS and PP groups. In the second phase, also fed for seven days, pigs that received the control and CS diets during phase 1 gained faster ($P<.05$) than the group supplemented with porcine plasma. Pigs offered common phase 2 diets that had previously received CS consumed less phase 2 feed/day ($P<.05$), and tended toward better feed and gain efficiency. When the common phase 3 diet was fed, no difference in ADG or feed efficiency was measured. Pig response for the combined 28-day period was variable depending on the criteria considered. There was no difference in ADG between treatments, but pigs started on pelleted CS consumed less feed/pound of gain compared to the control group, and tended to be more efficient when compared to the plasma diet. Feed cost/pound of gain favored the control starter. Feed costs/pound of gain were $.21, $.22, and $.23 for the control, commercial starter pellet, and plasma supplement, respectively, which translates into feed costs/pig of $3.86, $3.96, and $4.14 for the control, PP, and pelleted CS groups.

There was no advantage for using an antibiotic/antiserum treatment immediately post-weaning.

Experiment 2

Data for experiment 2 is shown in table 4. In this experiment, feeding time for common phase 2 and 3 diets was reversed. Following exposure to phase 1 diets for seven days, phase 2 was fed for 14 days and phase 3 for 7 days.

In phase 1, ADG and feed/head/day for the CS and PP were similar and greater (P<.05) than the control diet, however, feed efficiency was similar. Feed cost/pound of feed for the short 7 day period was considerably lower (P<.05) for the control group. Subsequent performance in phase 2 and 3 following phase 1 experimental starters favored the pelleted CS , in which ADG, feed intake and gain cost efficiency were better than either the control or plasma supplemented starters. For the full 28-day period, gain and feed consumption were higher for the pelleted CS pigs compared to the control starter. Performance of plasma supplemented pigs was intermediate. Gain performance for the 28 days translated into pigs that were 27.7% and 16.8% heavier for the CS and PP pigs, respectively. Economic efficiency favored the control group. Gain costs were $3.66, $4.58, and $5.28 for the control, plasma, and pelleted CS, respectively.

As in experiment 1, there was no advantage for using the antibiotic/antiserum treatment at weaning.

Experiment 3

In the third experiment, phase 1 feeding time was extended to 14 days and phases 2 and 3 were 7 days each. Data has been summarized in table 5. Average daily gain in phase 1 tended to be slightly greater for the pelleted CS, but the feed to gain ratio was significantly better (P<.05). Feed cost/pound of gain for the CS was much higher (P<.05). Subsequent growth during phases 2 and 3 were remarkably good for all starter types. Pelleted starter groups had faster gains (P<.05), though, and consumed less daily feed in phase 2, but in phase 3 consumption was higher. Significant differences in feed efficiency were not measured during phases 2 and 3, however, a trend toward improved feed efficiency following the CS was recorded. Feed cost/pound of gain also tended to favor the pelleted starter, but was not of sufficient magnitude to offset the cost of feeding the pellet for 14 days in phase 1. For the 28-day nursery period, the pelleted CS resulted in faster ADG, increased feed consumption, improved feed efficiency and higher cost/pound of gain (P<.05). Compared to the pelleted CS, the control and plasma supplemented pigs were 23.2% and 26.3% lighter, respectively. Feed cost/pound of gain favored the control pigs that cost $.05 less/pound of gain than either the plasma or pelleted CS. Gain costs were $4.03, $4.70, and $6.38 for the control, PP, and pelleted CS groups.

Antibiotic/antiserum treatment was of no advantage in experiment 3 either.

DISCUSSION

These data are preliminary. Each experiment must be evaluated separately, since they were not conducted simultaneously. As preliminary studies, they provide the database from which future nursery studies can be developed.

Viewing the three separate experiments, one can easily detect dramatically different responses with respect to a desirable performance/economic balance. Piglet response in experiment 1 was unresponsive in the second and third phases. Subsequent response following starter diets didn't demonstrate sufficient amplitude, with respect to gain performance and associated parameters. Since each dietary phase contained progressively less dried whey, it would appear that the progression through phases 1 and 2 to phase 3 was too rapid for the immature digestive systems of young pigs in transition, and experiencing weaning stress.

Spray-dried porcine plasma was added at 4% of the diet as a replacement for nearly all of the fish meal. Hansen et al. (1993) found a progressive improvement over control pigs with each plasma addition from 2 to 10% of the diet. Kats et al. (1994) found that adding porcine plasma at levels greater than 4% of the diet did not improve gain to feed ratios. Since the 4% level was a practically priced level, and had been determined to be a pivotal level in other swine nursery research, it was selected to replace fishmeal at the 4% level in these experiments. Adding 4% plasma supported pig responses that were equal to, or slightly better than, the control diets, but were more costly/pound of gain.

Largest post-weaning pig responses were observed in experiments 2 and 3. Following longer phase 1 and 2 feeding periods, consistently greater pig responses were recorded for phases that were preceeded by the pelleted CS. Pig response in phase 2 appears to be a strong indicator of weaning transition success and nursery acclimitization.

Cost effective feeding management systems that give stressed weanling pigs a strong start are balanced systems. Of the feeding management regimes evaluated, experiment 2 demonstrated the most desirable performance/economic balance.

LITERATURE CITED

Hansen, J.A., J.L. Nelssen, R.A. Goodband and T.L. Weeden. 1993. Evaluation of animal protein supplements in diets of early weaned pigs. J. An. Sci., 71:1853- 1862.

Kats, L.J., L.L. Nelssen, M.D. Tokach, R.D. Goodband, J.A. Hansen and J.L. Laurin. 1994. The effect of spray dried porcine plasma on growth performance in the early weaned pig. J. Anim. Sci. 72:2075-2081.

Mahan, D.C., R.A. Easter, G.L. Cromwell,E.R. Miller and T.L. Veum. 1993. Effect of dietary lysine levels formulated by altering the ratio of corn: SBOM with or without dried whey and L-lysine-HCL in diets for weanling pigs. J. An. Sci., 71:1848-1852.

Patience, J.F. and P.A. Thacker. 1989. "Processing Diets for Swine" in *Swine Nutrition Guide*. Published by Prairie Swine Center, University of Saskatchewan, Saskatoon, Saskatchewan, Canada, S7N OWO, pp 214.

SAS. 1985. *SAS User's Guide: Statistics* (Version 5 Ed). SAS Inst. Inc., Cary, NC.

Table 1. Weanling pig diet composition fed during phase 1 and common diet formulations fed across treatments during phases 2 and 3.

EXPERIMENTAL DIET COMPOSITION, (%)					
	PHASE I			PHASE II	PHASE III
	CTRL	CTRL + PLASMA	COMMERCIAL STARTER		
Spr. Wheat	24.3	24.3		41.8	35.4
Barley	19.1	18.9		21.3	38.8
Whey	24.2	24.2		7.42	0.0

SBOM	19.2	19.2		17.8	18.0
Fish Meal	5.9	1.9		3.96	0.0
Soybean Oil	4.0	4.0		3.95	3.46
Tr. Mineral	1.45	1.45		1.7	2.0
Lysine	0.33	0.25		0.4	0.6
Vit B Comp.	0.164	0.164		0.197	0.166
Vit A,D&E	0.05	0.05		0.05	0.05
Copper Sulf.	0.08	0.08		0.08	0.05
Porcine Plasma	0.0	4.0		0.0	0.0
Mecadox Med.	1.22	1.22		0.62	0.62
Analysis (%):					
Dry Matter	89.6	89.6	89.6	89.4	89.0
C. Protein	20.7	21.3	20.0	19.9	18.3
C. Fat	5.7	5.4	7.5	5.6	4.9
C. Fiber	3.0	3.0	2.5	3.5	4.2
Calcium	0.81	0.70	---	0.88	0.71
Total Phos.	0.78	0.73	---	0.68	0.58

Avail. Phos.	0.54	0.42	---	0.44	0.31
Lysine	1.50	1.50	1.50	1.38	1.29
Met. En (kcal)	3234	3253	---	3246	3179
Cost/lb., $	.1915	.2777	.3600	.1309	.0939

Table 2. Feeding intervals evaluated in objective 2.			
FEEDING INTERVALS (Days)			
PHASE:	**PHASE I**	**PHASE II**	**PHASE III**
Expt. 1	7	7	14
Expt. 2	7	14	7
Expt. 3	14	7	7

Table 3. Combined growth and antibiotic/antiserum treatment on performance and piglet response to dietary phase changes [Expt.1]
Phase Lengths: Phase 1 = 7 Da, Phase 2 = 7 Da, Phase 3 = 14 Da
COMBINED PERFORMANCE

Item	Control	Pellet	Plasma	SEM
Starting Wt.	15.1	14.4	14.5	-
End Wt.	33.5	33.2	31.7	-
Gain	18.4	18.8	17.2	-
ADG	.66	.67	.61	.030
Fd/Hd/Da	1.22[a]	1.13[ab]	1.05[b]	.040
Fd:Gain	1.87[a]	1.68[b]	1.74[ab]	.058
Fd Cost/Hd/Da	$.14	$.15	$.14	.005
Fd Cost:Gain	$.21	$.22	$.23	.006

COMBINED PERFORMANCE - ANTIBIOTIC/ANTISERUM			
	WITH	**WITHOUT**	**SEM**
ADG	.63	.66	.30
Fd/Hd/Da	1.12	1.15	.493
Fd : Gain	1.80	1.74	.403
Fd Cost/Hd/Da	$.14	$.14	.668

Fd Cost : Gain	$.22	$.21	.195

PHASE PERFORMANCE										
Days Fed	**PHASE 1**			**PHASE 2**			**PHASE 3**			
	7			**7**			**14**			
Item	**Ctrl**	**Pel**	**Plas**	**Ctrl**	**Pel**	**Plas**	**Ctrl**	**Pel**	**Plas**	**SEM**
ADG	.35	.41	.41	.75[a]	.70[a]	.57[b]	.76	.79	.73	.034
Fd/Hd/Da	.50	.50	.61	1.13[a]	.95[b]	.91[b]	1.63[a]	1.53[a]	1.35[b]	.033
Fd:Gain	1.42	1.22	1.68	1.52	1.35	1.67	2.17	1.95	1.87	.127
Fd Cost/Hd/Da	$.10[a]	$.18[b]	$.17[b]	$.15[a]	$.12[b]	$.12[b]	$.15[a]	$.14[ab]	$.13[b]	.006
Fd Cost : Gain	$.27[a]	$.44[b]	$.47[b]	$.20	$.18	$.22	$.20	$.18	$.18	.023
a,b,c Values in same row with different superscripts differ (P<.05).										

Table 4. Combined growth and antibiotic/antiserum treatment on performance and piglet response to dietary phase changes [Expt.2]				
Phase Lengths: Phase 1 = 7 Da, Phase 2 = 14Da, Phase 3 = 7				
COMBINED PERFORMANCE				
Item	**Control**	**Pellet**	**Plasma**	**SEM**

Starting Wt.	15	15.7	15.2	
End Wt.	30.9	37.7	33.5	
Gain	15.9	22.0	18.3	
ADG	.56[a]	.79[b]	.65[ab]	.032
Fd/Hd/Da	.99[a]	1.31[c]	1.18[b]	.036
Fd : Gain	1.79	1.68	1.81	.052
Fd Cost/Hd/Da	$.13[a]	$.19[c]	$.16[b]	.005
Fd Cost : Gain	$.23	$.24	$.25	.011

COMBINED PERFORMANCE - ANTIBIOTIC/ANTISERUM			
	WITH	**WITHOUT**	**SEM**
ADG	.63	.70	.091
Fd/Hd/Da	1.12[a]	1.21[b]	.044
Fd:Gain	1.79	1.74	.416
Fd Cost/Hd/Da	$.15[a]	$.17[b]	.047
Fd Cost:Gain	$.25	$.24	.504

PHASE PERFORMANCE										
	PHASE 1			PHASE 2			PHASE 3			
DAYS FED	**7**			**14**			**7**			
Item	**Ctrl**	**Pel**	**Plas**	**Ctrl**	**Pel**	**Plas**	**Ctrl**	**Pel**	**Plas**	**SEM**
ADG	$.35^{a}$	$.47^{ab}$	$.51^{b}$	$.63^{a}$	$.88^{b}$	$.68^{a}$	$.64^{a}$	$.91^{b}$	$.74^{a}$	.035
Fd/Hd/Da	$.50^{a}$	$.62^{ab}$	$.71^{b}$	1.03^{a}	1.37^{b}	1.16^{a}	1.43^{a}	1.89^{c}	1.68^{b}	.038
Fd : Gain	1.49	1.32	1.42	1.66	1.56	1.73	2.34	2.09	2.28	.107
Fd Cost/Hd/Da	$\$.10^{a}$	$\$.23^{c}$	$\$.20^{b}$	$\$.14^{a}$	$\$.18^{b}$	$\$.15^{a}$	$\$.13^{a}$	$\$.18^{b}$	$\$.16^{c}$	.007
Fd Cost : Gain ADG	$\$.28^{a}$	$\$.48^{c}$	$\$.39^{b}$	$.22	$.20	$.23	$.22	$.20	$.21	.016
a,b,c Values in same row with different superscripts differ (P<.05).										

Table 5. Combined growth and antibiotic/antiserum treatment on performance and piglet response to dietary phase changes [Expt.3]				
Phase Lengths: Phase 1 = 14 Da, Phase 2 = 7 Da, Phase 3 = 7 Table				
COMBINED PERFORMANCE				
Item	**Control**	**Pellet**	**Plasma**	**SEM**
Starting Wt.	12.2	12.1	11.9	
End Wt.	29.7	34.9	28.7	

Gain	17.5	22.8	16.8	
ADG	.62^{a}	.81^{b}	.60^{a}	.024
Fd/Hd/Da	1.06^{a}	1.26^{b}	1.03^{a}	.035
Fd : Gain	1.71^{a}	1.55^{b}	1.72^{a}	.035
Fd Cost/Hd/Da	$.14^{a}	$.22^{b}	$.17^{a}	.005
Fd Cost : Gain	$.23^{a}	$.28^{b}	$.28^{b}	.006

COMBINED PERFORMANCE - ANTIBIOTIC/ANTISERUM			
	WITH	**WITHOUT**	**SEM**
ADG	.68	.68	.776
Fd/Hd/Da	1.10	1.13	.456
Fd : Gain	1.63	1.68	.167
Fd Cost/Hd/Da	$.18	$.18	.34
Fd Cost : Gain	$.26	$.27	.07

PHASE PERFORMANCE			
	PHASE 1	**PHASE 2**	**PHASE 3**

DAYS FED	14			7			7			
Item	Ctrl	Pel	Plas	Ctrl	Pel	Plas	Ctrl	Pel	Plas	SEM
ADG	.43	.53	.43	.69[a]	.99[b]	.66[a]	.95[a]	1.21[b]	.88[a]	.042
Fd/Hd/Da	.64	.68	.68	1.22[a]	1.58[b]	1.13[a]	1.74[a]	2.11[b]	1.64[a]	.042
Fd : Gain	1.52[b]	1.29[a]	1.57[b]	1.80	1.60	1.75	1.85	1.74	1.90	.042
Fd Cost/Hd/Da	$.12[a]	$.25[c]	$.19[b]	$.16[a]	$.21[b]	$.15[a]	$.16[a]	$.20[b]	$.15[a]	.042
Fd Cost : Gain	$.29[a]	$.47[c]	$.43[b]	$.23	$.21	$.23	$.17	$.16	$.18	.042
a,b,c Values in same row with different superscript letters differ (P<.05).										

Back to 1995 Research Report Table of Contents
Back to Research Reports
Back to Dickinson Research Extension Center (http://www.ag.ndsu.nodak.edu/dickinso/)
Email: drec@ndsuext.nodak.edu