Effects of Diet Form and Feeder Adjustment on Growth Performance of Growing-Finishing Pigs[1]

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Summary

A total of 252 pigs (PIC 327 × 1050, initially 125.2 lb BW) were used in a 69-d trial to determine the effects of diet form and feeder adjustment on growth performance of growing-finishing pigs. Treatments were arranged in a 2 × 3 factorial with the main effects of feeder adjustment and diet form. The 2 feeder adjustments were a narrow feeder adjustment (minimum gap opening of 0.50 in.) and a wide adjustment (minimum gap opening of 1.00 in.). The feeders were adjusted to the minimum gap setting, but the agitation plate could be moved upward to a maximum gap opening of 0.75 or 1.25 in. for the narrow and wide adjustments, respectively. The 3 diet forms were meal, poor-quality pellets (50% pellets and 50% fines), and screened pellets with minimal fines. Average daily gain, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 0, 12, 22, 39, 48, and 69. No diet form × feeder adjustment interactions were observed ($P > 0.24$). For Phases 1 (d 0 to 22) and 2 (d 22 to 48), feeder adjustment did not influence ($P > 0.28$) ADG, but ADFI tended to increase ($P < 0.07$) and F/G worsened ($P < 0.05$) for pigs fed from the wide adjusted feeders. In Phase 3 (d 48 to 69), no differences were detected in growth performance ($P > 0.17$) between pigs fed from either feeder adjustment.

Overall (d 0 to 69), ADG did not differ between pigs fed from the 2 feeder adjustments, but ADFI decreased ($P < 0.03$) and F/G was improved ($P < 0.03$) for pigs fed from the narrow adjusted feeders. The response to diet form was similar among phases, with pigs fed meal diets having decreased ($P < 0.05$) overall ADG compared with pigs fed the screened pelleted diets and with those fed poor-quality pellets intermediate. Feeding screened pellets resulted in decreased ($P < 0.004$) ADFI and improved ($P < 0.001$) F/G compared with pigs fed meal diets, with those fed poor-quality pellets intermediate.

In conclusion, reducing feeder gap to manage feeder pan coverage helped to reduce feed wastage and improve feed efficiency. Also, feeding pelleted diets improved feed efficiency in all phases, but the magnitude of improvement was greatest when the percentage of fines in the diet was minimized.

Key words: diet form, feeder adjustment, pellet, finishing pig

Introduction

With the increasing cost of cereal grains, the need to minimize feed wastage and improving feed efficiency is becoming more apparent in the swine industry. Two

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methods that have shown benefits in F/G are managing feeder adjustment and pelleting swine diets; however, little research has been conducted to investigate the relationship between these two methods. Previous research has suggested that feeder adjustment has little influence on feed wastage for nursery pigs (see "Effect of Diet Form and Feeder Adjustment on Growth Performance of Nursery Pigs," p. 278). Conversely, experiments with growing-finishing pigs have shown that feed wastage can be minimized and F/G improved with proper feeder adjustment (Bergstrom et al., 2010[4]; Myers et al., 2010a[5]b[6]). Pelleting diets also has been shown to improve F/G, but the magnitude of improvement is influenced by pellet quality and the percentage of fines in the feed. More research is required to optimize feed efficiency and determine the relationship between feeder gap adjustment and diet form. Thus, the objective of this experiment was to determine the effects of feeder adjustment and diet form on growth performance of growing-finishing pigs.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the K-State Swine Teaching and Research Center in Manhattan, KS. The facility was a totally enclosed, environmentally regulated, mechanically ventilated barn containing 36 pens (8 ft × 10 ft). Each pen was equipped with a cup waterer and a single-sided, dry self-feeder (Farmweld, Teutopolis, IL) with 2 eating spaces located in the fence line. Pens were located over a completely slatted concrete floor with a 4-ft pit underneath for manure storage. The facility was also equipped with a computerized feeding system (FeedPro; Feedlogic Corp., Willmar, MN) that delivered and recorded diets as specified. The equipment provided pigs with ad libitum access to food and water.

A total of 245 pigs (PIC 327 × 1050, initially 125.2 lb BW) were used in a 69-d trial. Pens were randomly allotted to 1 of 6 experimental treatments. There were 5 pens per treatment with 7 pigs per pen and 1 replicate with 6 pigs per pen. To ensure equal floor space among pens of 7 and 6 pigs, the gating was adjusted to provide 8 ft^2/pig during the study. Treatments were arranged in a 2 × 3 factorial with the main effects of feeder adjustment and diet form. The 2 feeder adjustments were a narrow adjustment (minimum gap opening of 0.50 in.) and a wide adjustment (minimum gap opening of 1.00 in.). The feeders were adjusted to the minimum gap setting, but the agitation plate could be moved upward to a maximum gap opening of 0.75 or 1.25 in. for the narrow and wide adjustment, respectively. The 3 diet forms were meal, poor-quality pellets (50% pellets and 50% fines), and screened pellets with minimal fines. Common diets containing 20% DDGS were fed in 3 phases from d 0 to 22, d 22 to 48, and d 48 to 69 (Table 1). Average daily gain, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 0, 12, 22, 39, 48, and 69. Pictures were taken of feeder pan coverage once during each phase. The feeder pan pictures were then scored by a panel of 5 evaluators for percentage of pan coverage (Table 2).

Diets were prepared and pelleted at Hubbard Feeds in Atlantic, IA. Pellets were manufactured and fines were screened off and collected. After the screened pelleted diet was

[4] Bergstrom et al., Swine Day 2010, Report of Progress 1038, pp. 190–200.
[5] Myers et al., Swine Day 2010, Report of Progress 1038, pp. 166–171.
[6] Myers et al., Swine Day 2010, Report of Progress 1038, pp. 172–177.

bagged, the fines were added back to the remaining pellets. The mixture of pellets and fines was then passed through the roller mill to create the additional fines required for the poor-quality pellets. Feed samples were taken at the feeder during each phase. At the end of the experiment, percentage fines were measured on a composite of feed for pelleted diets from each phase. Fines were characterized as material that would pass through a #6 sieve (3,360-μm openings).

Experimental data were analyzed as a completely randomized design using the PROC MIXED procedure of SAS (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. Treatments were arranged as a 2 × 3 factorial with 2 feeder adjustments and 3 diet forms. Differences between treatments were determined using the PDIFF statement in SAS. Significant differences were declared at $P < 0.05$ and trends were declared at $P < 0.10$.

Results and Discussion

No interactions were observed between feeder adjustment and diet form during any of the dietary phases or for the overall study.

For Phase 1 (d 0 to 22), the narrow feeder adjustment pan coverage scores for the meal, poor-quality pellets, and screened pellets diets were 31, 49, and 44%, respectively (Figures 1, 2, and 3, respectively). The wide feeder adjustment pan coverage scores were 83, 96, and 86% for the meal, poor-quality pellets, and screened pellets diets, respectively (Figures 4, 5, and 6, respectively). When percentage fines were measured, the Phase 1 poor-quality pellets that were originally intended to contain 50% pellets and 50% fines actually contained 56% pellets and 44% fines (Table 3). The screened pelleted diet was 92% pellets and 8% fines. During Phase 1, there was no difference ($P > 0.61$) in ADG among pigs fed from feeders with the different adjustment settings (Tables 4 and 5). Pigs fed from feeders with the wide adjustment tended to have increased ($P < 0.07$) ADFI, which resulted in poorer ($P < 0.02$) F/G compared with pigs fed from feeders with the narrow adjustment. For diet form, ADG did not differ ($P > 0.32$) among treatments (Table 6). Pigs fed the meal diet had increased ($P < 0.04$) ADFI compared with pigs fed the poor quality pellets or screened pellets. Diet form had a significant impact on F/G during Phase 1, with pigs fed the meal diet having poorer ($P < 0.03$) F/G than pigs fed screened pellets, with those fed poor-quality pellets intermediate.

During Phase 2 (d 22 to 48), the narrow feeder adjustment pan coverage scores for the meal, poor-quality pellets, and screened pellets diets were 62, 77, and 69%, respectively (Figures 7, 8, and 9, respectively). The wide feeder adjustment pan coverage scores were 90, 99, and 92% for the meal, poor-quality pellets, and screened pellets diets, respectively (Figures 10, 11, and 12, respectively). The Phase 2 poor-quality pelleted diet contained 48% pellets and 52% fines, whereas the screened pelleted diet was 92% pellets and 8% fines. There was no difference ($P > 0.28$) in ADG among pigs fed from feeders with the different adjustment settings. Pigs fed from feeders with the wide adjustment had greater ($P < 0.02$) ADFI and poorer ($P < 0.05$) F/G than pigs fed from feeders with the narrow adjustment. For diet form, the pigs fed 50% pellets + 50% fines unexpectedly tended to have increased ($P < 0.06$) ADG compared with pigs fed either of the other 2 diet form treatments. Pigs fed the meal or poor-quality pelleted diets had increased ($P < 0.002$) ADFI compared with pigs fed the screened pellets. The response to diet form on feed efficiency was identical to Phase 1, in which pigs fed the screened pellets had the best ($P < 0.001$) F/G, pigs fed the meal diet had the poorest F/G, and pigs fed poor-quality pellets were intermediate.

The Phase 3 (d 48 to 69) narrow feeder adjustment pan coverage scores for the meal, poor-quality pellets, and screened pellets diets were 89, 93, and 92%, respectively (Figures 13, 14, and 15, respectively). The wide feeder adjustment pan coverage scores were 95, 99, and 96% for the meal, poor-quality pellets, and screened pellets diets, respectively (Figures 16, 17, and 18, respectively). The Phase 3 poor-quality pellets contained 45% pellets and 55% fines, whereas the screened pelleted diet was 90% pellets and 10% fines. There was no difference ($P > 0.17$) in ADG, ADFI, or F/G between pigs fed from feeders with the different adjustment settings during the final phase, although the numerical trends for ADFI and F/G were similar to previous phases. For diet form, pigs fed the meal diet had decreased ($P < 0.04$) ADG compared with pigs fed either of the pelleted diets, and pigs fed the pelleted diet had decreased ($P < 0.02$) ADFI compared with pigs fed the meal or poor-quality pellets. Similar to the previous 2 periods, pigs fed the screened pellets had the best ($P < 0.001$) F/G, pigs fed the meal diet had the poorest F/G, and pigs fed poor-quality pellets were intermediate.

Overall (d 0 to 69), feeder adjustment had no effect ($P > 0.46$) on ADG. Responses from Phases 1 and 2 carried over into the overall data, resulting in decreased ($P < 0.03$) ADFI and improved ($P < 0.03$) F/G in pigs fed from the narrow adjusted feeders. Pigs fed meal diets had decreased ($P < 0.05$) ADG compared with pigs fed the screened pelleted diets, with pigs fed poor-quality pellets intermediate. Feeding screened pellets resulted in decreased ($P < 0.004$) ADFI compared with pigs fed poor-quality pellets or meal diets. Consistent in all 3 phases, pigs fed screened pellets had improved ($P < 0.001$) F/G compared with pigs fed the meal diet, and those fed poor-quality pellets were intermediate.

In summary, feeder adjustment did not influence ADG in this study. This lack of response is probably due to the relatively high feeder pan coverage on the narrow feeder adjustment. Increasing pan coverage further with the wide adjustment increased feed wastage and resulted in poorer F/G. At the same feeder setting, feeder pan coverage scores increased over time for the narrow feeder setting. This may explain why a significant benefit in F/G was observed for the narrow feeder adjustment during the first two phases, but not during the final phase. Thus, monitoring feeder gap opening to properly manage feeder pan coverage can help minimize feed wastage and improve feed efficiency in finishing pigs. This result seems to suggest that decreased feeder gap opening should be used for feeding heavier weight pigs. As expected, diet form also had a significant impact on F/G, because pigs fed the meal diet had the poorest F/G, pigs fed screened pellets had the best F/G, and pigs fed poor-quality pellets were intermediate. This confirms previous research that feeding pelleted diets improves feed efficiency, but the magnitude of improvement was greatest when the percentage of fines in the diet was minimized.

Table 1. Diet composition (as-fed basis)

Item	Phase 1[1]	Phase 2[2]	Phase 3[3]
Ingredient, %			
Corn	59.76	63.08	76.04
Soybean meal (46.5% CP)	17.05	14.00	11.65
Dried distillers grains with solubles	20.00	20.00	10.00
Choice white grease	1.35	1.15	0.75
Limestone	1.01	0.99	0.85
Salt	0.35	0.35	0.35
Trace mineral premix	0.10	0.10	0.09
Vitamin premix	0.03	0.03	0.03
L-lysine HCl	0.30	0.25	0.20
Selenium (0.2% Se)	0.015	0.015	0.015
Phytase[4]	0.041	0.041	0.041
Total	100	100	100
Calculated analysis			
Standardized ileal digestible amino acids, %			
Lysine	0.90	0.79	0.67
Isoleucine:lysine	68	71	71
Leucine:lysine	172	188	189
Methionine:lysine	32	35	35
Met & Cys:lysine	62	68	69
Threonine:lysine	55	64	64
Tryptophan:lysine	18	19	19
Valine:lysine	83	88	88
Total lysine, %	1.04	0.92	0.77
ME, kcal/lb	1,520	1,520	1,523
CP, %	17.7	16.5	13.7
Ca, %	0.48	0.47	0.40
P, %	0.42	0.40	0.35
Available P, %	0.26	0.25	0.25

[1] Phase 1 diets were fed from d 0 to 22.
[2] Phase 2 diets were fed from d 22 to 48.
[3] Phase 3 diets were fed from d 48 to 69.
[4] Phyzyme 600 (Danisco Animal Nutrition, St. Louis, MO) provided 460 phytase units (FTU)/lb, with a release of 0.13% available P.

Table 2. Analysis of pan coverage

	Maximum feeder adjustment					
	0.75 in.			1.25 in.		
Item	Meal	50% pellet + 50% fine	Screened pellet	Meal	50% pellet + 50% fine	Screened pellet
Pan coverage, %[1]						
Phase 1	31	49	44	83	96	86
Phase 2	62	77	69	90	99	92
Phase 3	89	93	92	95	99	96

[1] Pictures were taken of feeder pan coverage once during each phase. The feeder pan pictures were then scored by a panel of 5 evaluators for percentage of pan coverage.

Table 3. Analysis of percentage fines of pelleted diets[1]

Item	50% pellet + 50% fine	Screened pellet
Percentage fines, %[2]		
Phase 1	44	8
Phase 2	52	8
Phase 3	55	10

[1] Feed samples were taken at the feeder during each phase.
[2] Fines were characterized as material that would pass through a #6 sieve (3,360-μm openings).

Table 4. Effect of diet form and feeder adjustment on growing-finishing pig growth performance[1]

	Maximum feeder adjustment								
	0.75 in.			1.25 in.				Probability, $P<$[2]	
	Meal	50% pellet + 50% fine	Screened pellet	Meal	50% pellet + 50% fine	Screened pellet	SEM	Diet form[3]	Narrow vs. wide
d 0 to 22									
ADG, lb	2.13	2.06	2.20	2.16	2.12	2.19	0.065	0.32	0.61
ADFI, lb	5.06	4.69	4.75	5.30	5.06	4.84	0.151	0.04	0.07
F/G	2.37	2.27	2.17	2.45	2.38	2.22	0.040	0.001	0.02
d 22 to 48									
ADG, lb	2.16	2.32	2.22	2.26	2.32	2.25	0.046	0.06	0.28
ADFI, lb	5.94	5.78	5.46	6.36	6.29	5.58	0.168	0.002	0.02
F/G	2.76	2.49	2.46	2.83	2.72	2.48	0.061	0.001	0.05
d 48 to 69									
ADG, lb	2.00	2.19	2.22	2.07	2.16	2.20	0.070	0.04	0.93
ADFI, lb	7.18	7.33	6.84	7.85	7.50	6.82	0.240	0.02	0.17
F/G	3.60	3.35	3.09	3.80	3.49	3.10	0.113	0.001	0.20
d 0 to 69									
ADG, lb	2.10	2.20	2.21	2.17	2.21	2.21	0.043	0.08	0.46
ADFI, lb	6.04	5.89	5.64	6.47	6.25	5.72	0.159	0.004	0.03
F/G	2.87	2.68	2.55	2.98	2.83	2.58	0.053	0.001	0.03
BW, lb									
d 0	125.2	125.2	125.2	125.2	125.1	125.2	2.62	0.99	0.99
d 22	172.1	172.4	173.4	173.3	171.8	173.6	3.33	0.91	0.93
d 48	228.2	232.8	232.4	231.6	233.2	232.1	4.10	0.73	0.89
d 69	270.2	280.4	279.0	275.0	278.5	278.3	4.67	0.29	0.85

[1] A total of 252 finishing pigs (PIC 327 × 1050) were used with 7 pigs per pen and 6 pens per treatment.
[2] No interactions were observed between treatments ($P > 0.05$).
[3] Compares the main effect of diet form (comparing meal vs. poor-quality pellet vs. screened pellet).

Table 5. Main effects of feeder adjustment on growing-finishing pig growth performance[1]

	Maximum feeder adjustment			
	0.75 in.	1.25 in.	SEM	Probability, *P*<
d 0 to 22				
ADG, lb	2.13	2.16	0.037	0.61
ADFI, lb	4.83	5.07	0.087	0.07
F/G	2.27	2.35	0.023	0.02
d 22 to 48				
ADG, lb	2.23	2.27	0.027	0.28
ADFI, lb	5.73	6.08	0.097	0.02
F/G	2.57	2.67	0.035	0.05
d 48 to 69				
ADG, lb	2.14	2.14	0.040	0.93
ADFI, lb	7.11	7.39	0.138	0.17
F/G	3.35	3.47	0.065	0.20
d 0 to 69				
ADG, lb	2.17	2.20	0.025	0.46
ADFI, lb	5.85	6.15	0.092	0.03
F/G	2.70	2.80	0.031	0.03
Weight, lb				
d 0	125.2	125.2	1.51	0.99
d 22	172.7	172.9	1.92	0.93
d 48	231.1	232.3	2.37	0.89
d 69	276.5	277.2	2.70	0.85

[1]A total of 252 finishing pigs (PIC 327 × 1050) were used with 7 pigs per pen and 6 pens per treatment.

Table 6. Main effects of diet form on growing-finishing pig growth performance[1]

	Meal	50% pellet + 50% fines	Screened pellet	SEM	Probability, *P*<
d 0 to 22					
ADG, lb	2.15	2.09	2.19	0.046	0.32
ADFI, lb	5.18[a]	4.87[b]	4.80[b]	0.107	0.04
F/G	2.41[a]	2.33[b]	2.19[c]	0.028	0.001
d 22 to 48					
ADG, lb	2.21[a]	2.32[b]	2.24[a]	0.033	0.06
ADFI, lb	6.15[a]	6.04[a]	5.52[b]	0.119	0.002
F/G	2.79[a]	2.61[b]	2.47[c]	0.043	0.001
d 48 to 69					
ADG, lb	2.03[a]	2.18[b]	2.21[b]	0.049	0.04
ADFI, lb	7.51[a]	7.41[a]	6.83[b]	0.169	0.02
F/G	3.70[a]	3.42[b]	3.10[c]	0.080	0.001
d 0 to 69					
ADG, lb	2.14[a]	2.20[ab]	2.21[b]	0.030	0.08
ADFI, lb	6.25[a]	6.07[a]	5.68[b]	0.113	0.004
F/G	2.93[a]	2.76[b]	2.57[c]	0.038	0.001
Weight, lb					
d 0	125.2	125.1	125.2	1.85	0.99
d 22	172.7	172.1	173.5	2.35	0.91
d 48	229.9	233.0	232.3	2.90	0.73
d 69	272.6	279.5	278.6	3.30	0.29

[1] A total of 252 finishing pigs (PIC 327 × 1050) were used with 7 pigs per pen and 6 pens per treatment.
[a,b,c] Means on the same row with different superscripts differ, $P < 0.05$.

Figure 1. Phase 1 narrow feeder adjustment with meal diet (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 31% feeder pan coverage.

Figure 2. Phase 1 narrow feeder adjustment with 50% pellets and 50% fines (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 49% feeder pan coverage.

Figure 3. Phase 1 narrow feeder adjustment with screened pellets (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 44% feeder pan coverage.

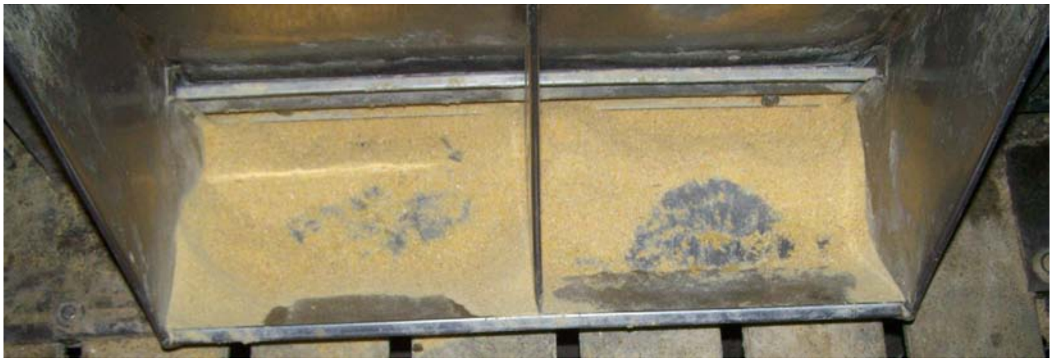

Figure 4. Phase 1 wide feeder adjustment with meal diet (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 83% feeder pan coverage.

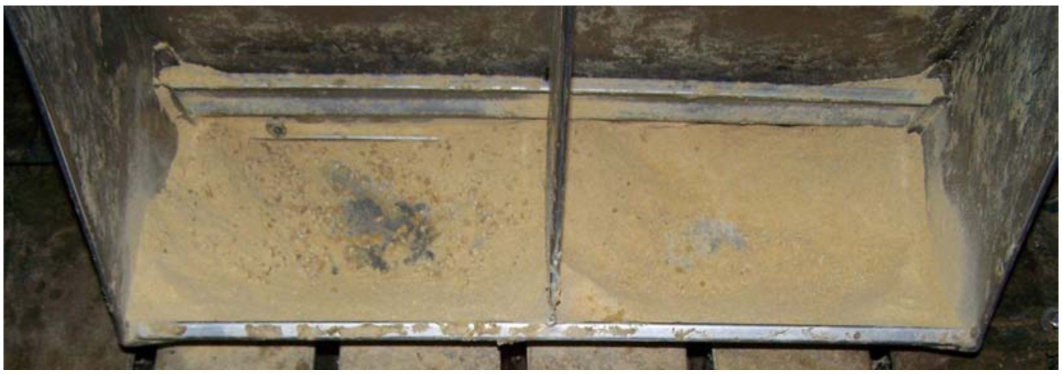

Figure 5. Phase 1 wide feeder adjustment with 50% pellets and 50% fines (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 96% feeder pan coverage.

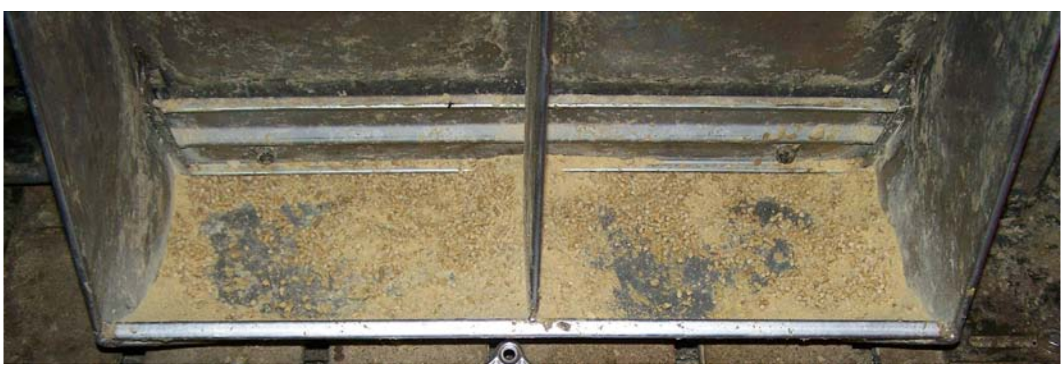

Figure 6. Phase 1 wide feeder adjustment with screened pellets (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 86% feeder pan coverage.

Figure 7. Phase 2 narrow feeder adjustment with meal diet (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 62% feeder pan coverage.

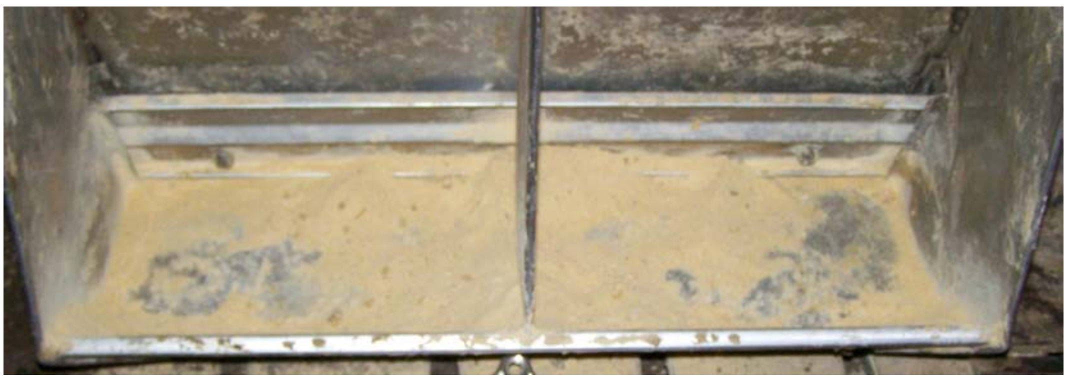

Figure 8. Phase 2 narrow feeder adjustment with 50% pellets and 50% fines (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 77% feeder pan coverage.

Figure 9. Phase 2 narrow feeder adjustment with screened pellets (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 69% feeder pan coverage.

Figure 10. Phase 2 wide feeder adjustment with meal diet (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 90% feeder pan coverage.

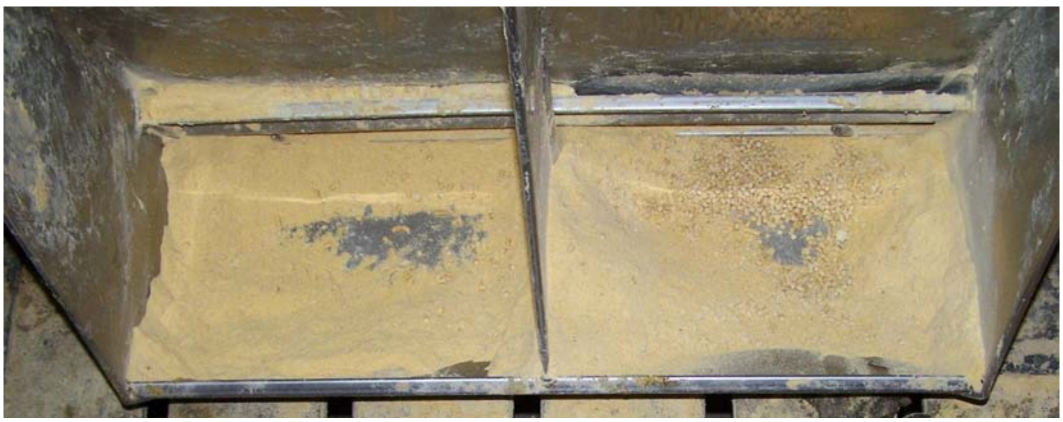

Figure 11. Phase 2 wide feeder adjustment with 50% pellets and 50% fines (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 99% feeder pan coverage.

Figure 12. Phase 2 wide feeder adjustment with screened pellets (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 92% feeder pan coverage.

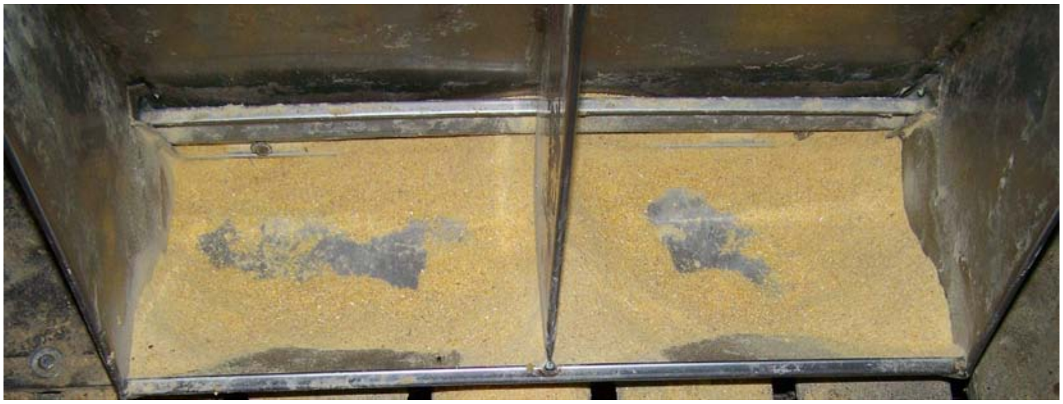

Figure 13. Phase 3 narrow feeder adjustment with meal diet (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 89% feeder pan coverage.

Figure 14. Phase 3 narrow feeder adjustment with 50% pellets and 50% fines (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 93% feeder pan coverage.

Figure 15. Phase 3 narrow feeder adjustment with screened pellets (minimum feeder gap was 0.5 in. with a maximum gap of 0.75 in.) averaged 92% feeder pan coverage.

Figure 16. Phase 3 wide feeder adjustment with meal diet (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 95% feeder pan coverage.

Figure 17. Phase 3 wide feeder adjustment with 50% pellets and 50% fines (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 99% feeder pan coverage.

Figure 18. Phase 3 wide feeder adjustment with screened pellets (minimum feeder gap was 1.00 in. with a maximum gap of 1.25 in.) averaged 96% feeder pan coverage.