EFFECTS OF DIFFERENT FEEDING REGIMENS ON GROWTH, LONGEVITY, AND SEMEN CHARACTERISTICS OF WORKING BOARS IN A COMMERCIAL AI STUD[1]

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Summary

The objective of the study was to determine the effects of 2 different feeding regimens on growth performance, semen production and quality, and longevity of boars in a commercial AI stud. A total of 30 replacement boars (PIC TR4, 375 lb and 14.2 mo of age) were randomly selected and allotted to 1 of 2 treatments. The control feeding program was the normal feeding program of the stud; boars were fed 6.7 lb/d for the first 8 wk, and then feeding was adjusted according to body condition of the individual boar. For the treatment feeding program, boars were fed 5.8 lb/d in the first 4 wk until boars reached 400 lb; afterward, boars were fed 6.0 lb/d for the duration of the study. Boars were weighed periodically to determine periodic and overall ADG. Semen was collected from each boar once a week for a total duration of 16 mo. Semen production and quality was determined for each ejaculate. Overall, treatment boars were consistently heavier than the control boars throughout the duration of the study because of their higher periodic and overall daily gains. At the end of the test, treatment boars were 32 lb heavier ($P < 0.15$) than the control boars. A higher proportion of treatment boars (73 vs. 42%) were active at the end of the study, which numerically increased ($P > 0.35$) average days in the stud (345 vs. 279 d), semen collections (58 vs. 49), and doses produced (1,238 vs. 1,077). There were no differences ($P > 0.28$) in the volume, sperm cell concentration, sperm cell count, and doses produced per ejaculate between boars fed the two feeding programs. Likewise, motility rates and proportion of normal cells in ejaculates were similar ($P > 0.33$) between boars fed the control and treatment feeding program. In conclusion, AI boars can be fed to a set feeding level to achieve targeted weight gains to influence longevity without affecting semen production and quality.

Key words: boars, growth rate, longevity, semen characteristics

Introduction

Despite the potential relationship between growth rate and reproductive performance, there is a lack of information on ideal growth rates of adult working boars. In previous studies, slow-growing boars fed at maintenance have shown significantly lower libido, semen volume, and sperm output. On the other hand, providing boars with high levels of feed to achieve fast growth is thought to induce leg

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and libido problems. Rate of weight gain may also affect longevity and, therefore, lifetime semen production. Different feeding programs can lead to varying rates of growth; however, different feeding regimens for AI boars have never been evaluated. Therefore, the objective of this study was to determine the effect of 2 different feeding regimens on growth performance, semen production and quality, and longevity of boars in a commercial AI stud.

Procedures

A total of 30 replacement boars (PIC TR4, 375 lb and 14.2 mo of age) were randomly selected for this study conducted at the AI stud facilities of Zoltenko Farms, Inc., in Hardy, NE. Boars were allotted to 2 treatments in a completely randomized design; there were 15 boars (replicates) per treatment. The 2 experimental treatments were (1) control and (2) treatment feeding programs. The control feeding program was the existing feeding program of the stud. Upon entry to the stud, feed drops were set to 6.7 lb/d for the first 8 wk. After this initial period, feed box settings were adjusted periodically according to a subjective assessment of body condition of each boar throughout its lifetime in the stud. For the treatment feeding program, boars were fed 5.8 lb/d for the first 4 wk until boars reached 400 lb. Afterward, boars were offered 6.0 lb/d throughout the duration of the study. In a previous study, it was determined that a 12% overage was the average difference between feed box setting and the actual amount of feed dispensed in this specific stud. To provide the desired feeding levels for the treatment boars, feed boxes were set at 5.2 lb/d in weeks 0 to 4 and 5.4 lb/d throughout the rest of the study. The feed boxes for the control boars initially were set at 6.0 lb/d; however, because of the overage, the actual amount of feed presented to control boars was 6.7 lb/d in weeks 0 to 8 and between 4.5 to 11.2 lb/d during the period when boars were fed according to body condition. All boars were fed a corn-soybean meal-based diet with 10% soy hulls, 5% dehydrated alfalfa, and a boar base mix formulated to contain 0.79% standardized ileal digesible lysine and 1,340 kcal ME/lb (Table 1). Boars were fed twice a day, and water was provided ad libitum. Boars were weighed periodically by using a platform scale to determine periodic and cumulative daily gains. Any adjustments of the feeder box settings during the study were also recorded. Total duration of the study was 16 mo.

Table 1. Composition of the boar diet (as-fed basis)[1]

Ingredient	%
Corn	57.50
Soybean meal (46.5% CP)	21.25
Soybean hulls	10.00
Alfalfa meal, dehydrated	5.00
Boar base mix	6.25
Total	100.00
Calculated analysis	
CP, %	17.4
Standardized ileal digestible lysine, %	0.79
ME, kcal/lb	1,343
Ca, %	1.14
Available P, %	0.54

[1] Fed in meal form.

Semen was collected from each boar once a week on a dummy by using the hand glove technique with an average rest period of 5.3 d. The first collection was performed a week prior to the start of the experiment. For semen production, the volume of each ejaculate was measured immediately after collection. The concentration and number of sperm cells and the number of doses per ejaculate were also determined. Semen quality was assessed on the basis of sperm motility and the rate of normal cells per ejaculate. Each ejaculate was also evaluated for morphological defects such as distal and proximal droplets, loose heads, acrosome defects, pouch formations, and abnormal midpieces. Semen collections were trashed for the presence of morphological

defects, poor motility, bloody semen, or sterility. Trashed collections (due to morphological defects) were recorded with the date and reason for trashing. Boars were removed according to the culling standards of the stud. The date and reason for culling were recorded. Because 3 of the boars in the control feeding program were culled early because they were untrainable for semen collections, only 12 control boars were included in the analysis.

Data were analyzed by using the GLM procedure of SAS for a completely randomized design with boar as the experimental unit. Treatments were separated by using the LSMEANS statement and the PDIFF option of SAS. An alpha level of 0.05 was used to assess the significance between least square means.

Results and Discussion

The effect of the 2 feeding programs on live weight of boars in a commercial AI stud is shown in Figure 1. Boars on the control feeding program were 2.1% heavier (446 vs. 437 lb) than the boars on the treatment feeding program after the initial 8-wk period. This was expected because control boars were provided 0.7 to 0.9 lb more feed and had greater daily gains (weeks 0 to 8: 1.14 vs. 0.97 lb/d) during this period. However, control boars became lighter (wk 14: 452 vs. 464 lb) than the treatment boars immediately after the initial period. This change in the weight trend reflects the adjustment in the feeding program when control boars were fed according to body condition. After wk 14, boars on the treatment feeding program were consistently heavier than the boars on the control feeding program throughout the duration of the study. Treatment boars were significantly heavier ($P < 0.06$) at wk 18, 34, and 54. At the end of the test, treatment boars were 32 lb heavier ($P < 0.15$) than the control boars.

Except from wk 0 to 4 (Figure 2), boars on the treatment feeding program achieved higher periodic daily gains as boars increased in weight from 400 to 500 lb (wk 4 to 24: 0.67 vs. 0.55 lb/d) and 500 to 600 lb (wk 24 to 64: 0.33 vs. 0.28 lb/d), though differences were not significant ($P > 0.32$). Overall daily gains of treatment boars were numerically higher ($P < 0.39$; 0.51 vs. 0.46 lb/d) than those of boars on the control feeding program. With the treatment feeding program, boars showed a steady decline in daily gains from 0.84 lb/d in wk 4 to 0.33 lb/d at wk 64 (Figure 3). The variation in weight gains of individual treatment boars is shown in Figure 4. At a constant feed box setting, weight gains varied from boar to boar in each period. This may reflect animal differences or daily variations in the actual amount of feed dispensed from each feed box. However, all of the treatment boars were on a positive plane of growth throughout the study.

Boars on the control feeding program showed a more erratic pattern of growth rates with wide swings in daily gains throughout the study (Figure 3). Boars on the control feeding program had greater ($P < 0.14$) ADG than the treatment boars from wk 0 to 4 (1.04 vs. 0.84 lb/d) and from wk 54 to 64 (0.70 vs. 0.33 lb/d). In contrast, control boars had lower ($P < 0.14$) daily gains than the treatment boars from wk 8 to 14 (0.31 vs. 0.75 lb/d) and 28 to 34 (0.15 vs. 0.46 lb/d). These big changes in growth rates among the control boars suggest a cyclic pattern of increasing and decreasing feed allocation of individual boars to either reduce or compensate body condition (Figure 5). Boars were fed as much as 11.2 lb/d when they were below the farm's acceptable body condition and as little as 4.5 lb/d when individual boars were believed to need to lose condition. At this low level of feeding, boars were potentially being fed close to or below their maintenance requirements. This also highlights another problem—the boar stud failed to account for the differences between the feed box settings and the actual amount of feed dispensed.

It is important to check and account for these differences to accurately develop feeding programs.

Using the factorial approach, we determined the predicted weight gains of the treatment boars on the basis of their actual feed allocation (Table 1). The estimated total energy intake of the boars was 7.8 Mcal ME/d in wk 0 to 4 and 8.1 Mcal ME/d from wk 4 until the end of the study. The total energy requirement of the treatment boars for maintenance, mating activity, and sperm production increased from 5.86 Mcal ME at 376 lb to 8.03 Mcal ME at 607 lb BW. Therefore, the estimated ME difference for weight gain declined from 1.94 to 0.07 Mcal ME/d. This shows that with the constant feed allocation at 5.4 lb/d, the total energy intake of the boars approached maintenance as BW increased from 376 to 607 lb. The predicted weight gains of the treatment boars declined linearly from 0.88 to 0.03 lb/d for the entire duration of the study. The predicted weight gains of the treatment boars were plotted against their actual weight gains (Figure 6). The slope of the line for the actual weight gains (-0.0878) was 92.2% of the slope of the predicted weight gains (-0.0952), which indicates close agreement. The actual weight gains of the treatment boars were slightly greater than the predicted weight gains, which may be due to (1) differences in the energy value of some of the ingredients (i.e., soybean hulls) accounted in the feed formulation, (2) variations in the actual amount of feed dispensed from the boxes, or (3) differences between the predicted and actual animal efficiencies.

At the end of the 16-mo study, a higher proportion of active boars (73 vs. 42%) were maintained in boars fed the treatment feeding program (Figure 7). For the 10 control boars, 5 were culled because of poor semen quality, 3 were untrainable, 1 had a leg injury, and 1 died (identified as a twisted gut). All 4 boars culled from the treatment group were culled because of poor semen quality. Because there was a higher number of active boars maintained until the end of the test, boars under the treatment feeding program had greater total production days (+55%; 5,173 vs. 3,345 d), semen collections (+47%; 874 vs. 593), and doses produced (+47%; 18,569 vs. 12,619) than the control group (Table 3). However, the average production days (345 vs. 279 d/boar), number of semen collections (58 vs. 49 collections/boar), and number of doses produced (1,238 vs. 1,077 doses/boar) were only numerically improved ($P > 0.35$) in boars fed the treatment feeding program. There were no differences between the two treatments in the total and average number of semen collections trashed; however, the percentage of trashed collections was higher in the control group than in the treatment group (8.3 vs. 4.6%). The rate of morphological defects in trashed collections from the control and treatment groups was the same, with distal and proximal droplets making up more than half of the trashed collections. In terms of semen characteristics, there were no differences ($P > 0.28$) in the volume, sperm cell concentration, sperm cell count, and doses produced per ejaculate between boars fed the 2 feeding programs (Table 4). In other studies, plane of nutrition was found to significantly affect semen volume, especially in young boars. However, these differences were obtained when comparisons were made between boars fed above and below their nutrient requirements, which is not the case in the present study. Likewise, motility rates and proportion of normal cells in ejaculates were similar ($P > 0.33$) between boars fed the control and treatment feeding program. These results are consistent with previous studies in which varying levels of feed or energy intake of boars did not influence any semen quality variable.

In conclusion, AI boars can be fed to a set feeding level to achieve targeted weight gains to influence longevity without affecting semen production and quality. Because many of the

reasons for culling may not have been entirely due to feeding regimen, more research is required to validate that feeding regimen influences longevity of boars in the stud.

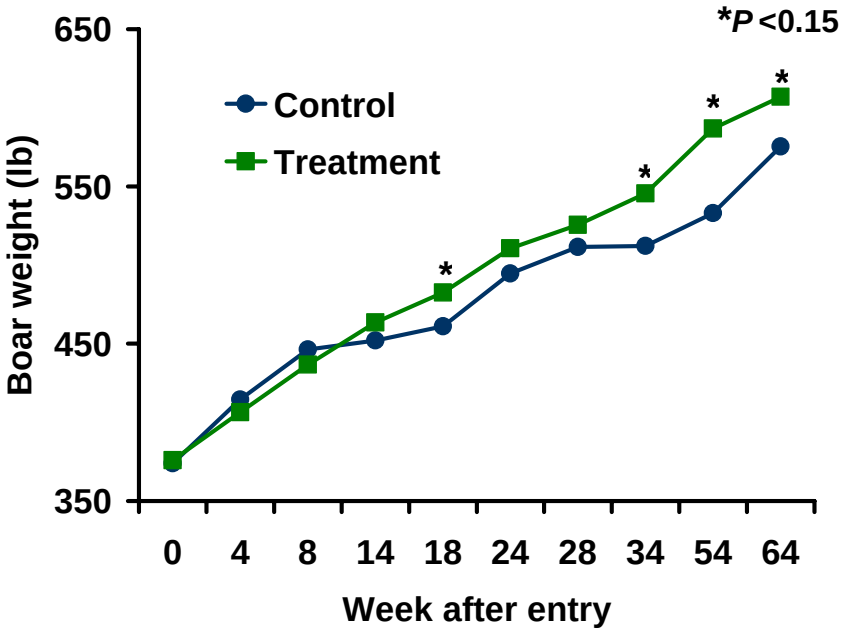

Figure 1. Effect of different feeding regimens on live weight of boars in a commercial AI stud.
(Control = 6.7 lb/d for wk 0 to 8 and then fed according to body condition, Treatment = 5.8 lb/d for wk 0 to 4 and then 6.0 lb/d until end of the study).

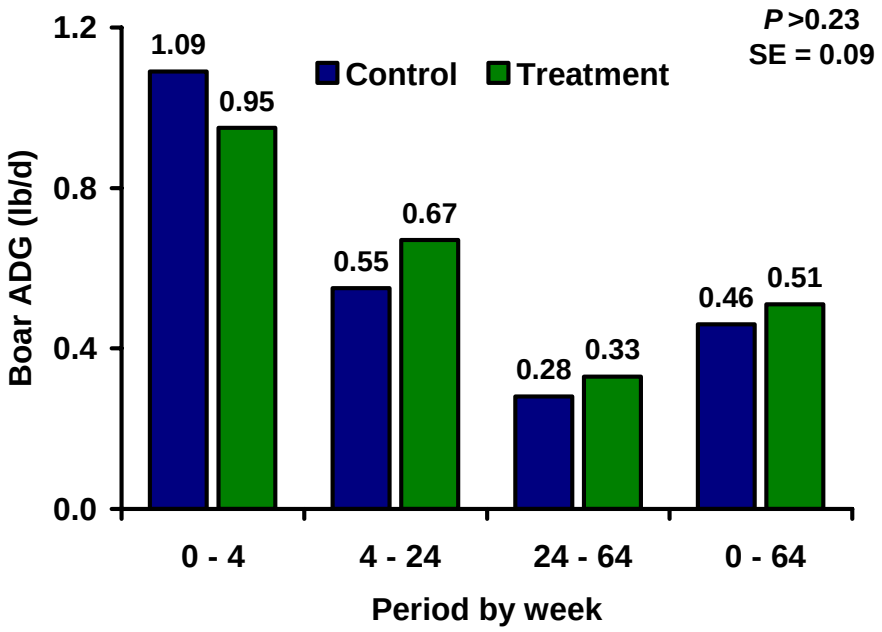

Figure 2. Effect of different feeding regimens on periodic and overall daily gains of boars in a commercial AI stud.
(Control = 6.7 lb/d for wk 0 to 8 then fed according to body condition, Treatment = 5.8 lb/d for wk 0 to 4 and then 6.0 lb/d until end of the study).

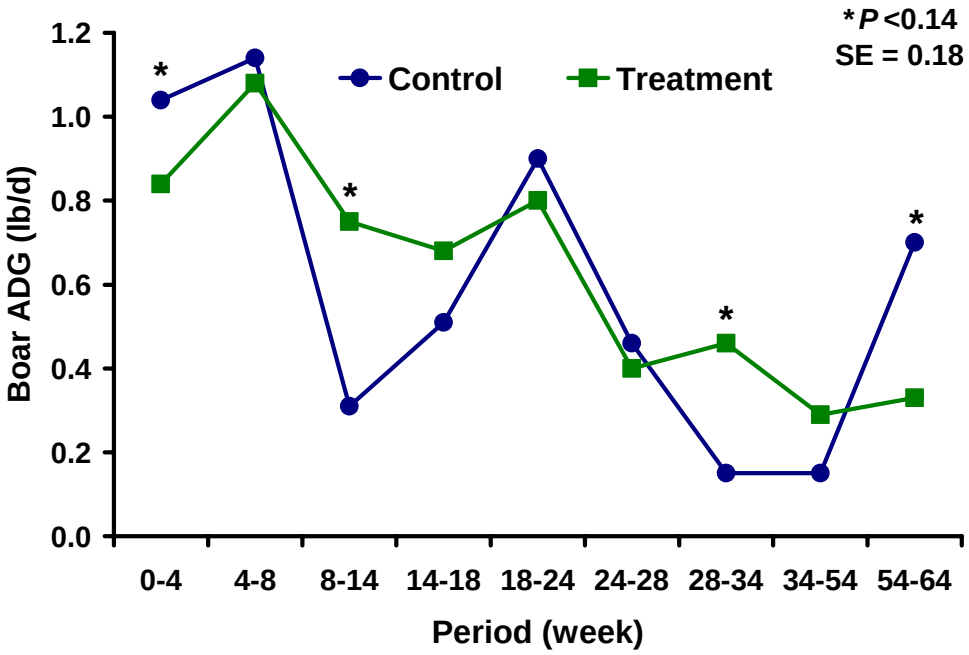

Figure 3. Effect of different feeding regimens on the pattern of growth rates of boars in a commercial AI stud.
(Control = 6.7 lb/d for wk 0 to 8 then fed according to body condition, Treatment = 5.8 lb/d for wk 0 to 4 and then 6.0 lb/d until end of the study).

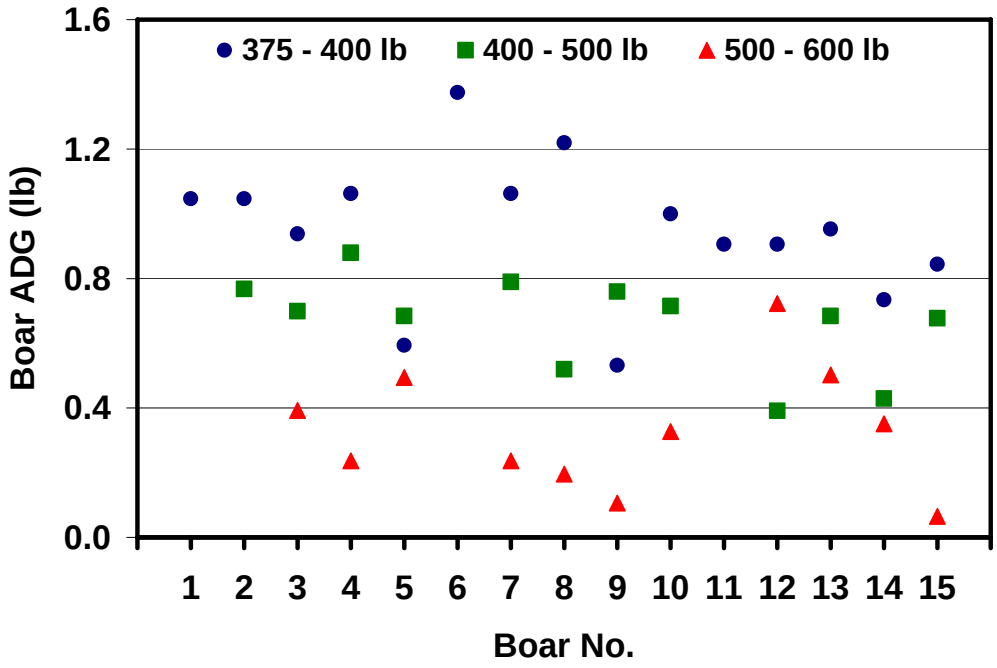

Figure 4. Variation in daily weight gains of treatment boars fed at constant feed box settings (5.8 lb/day at 375 to 400 lb and 6.0 lb/day at 400 to 600 lb BW).

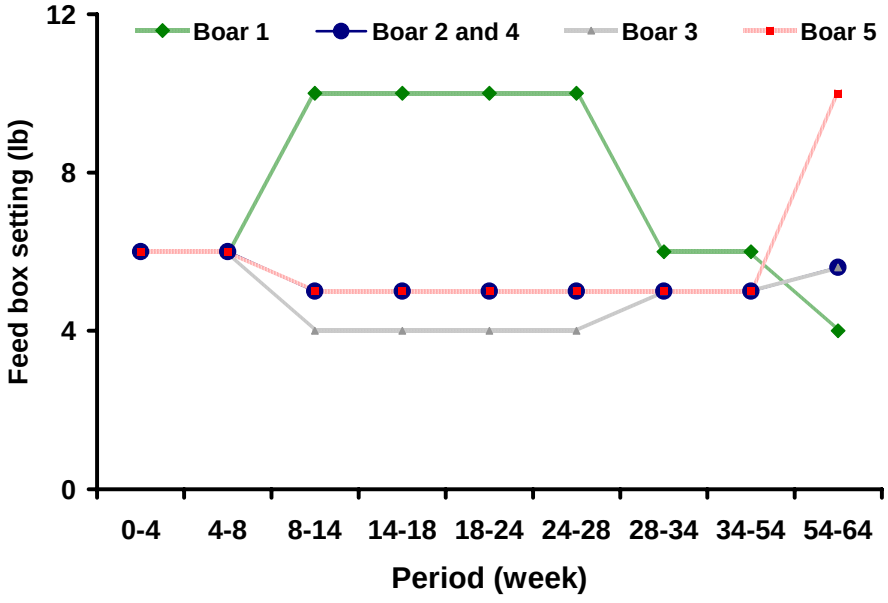

Figure 5. Feed box adjustments of individual boars in the control feeding program.

Table 2. Predicted daily weight gain of treatment boars

	Actual BW	Daily feed allocation		Estimated energy intake[2]	ME requirement			Total ME at wt gain = 0[6]	Difference[7]	Predicted wt gain[8]
		Box setting	+12% overage[1]		Maintenance[3]	Mating activity[4]	Sperm production[5]			
wk	lb	lb/d	lb/d	Mcal ME/d	Mcal ME	Mcal ME	Mcal ME	Mcal ME	Mcal ME/d	lb/d
0	376	5.2	5.8	7.80	5.56	0.20	0.10	5.86	1.94	0.88
4	406	5.4	6.0	8.10	5.85	0.22	0.10	6.17	1.94	0.87
8	437	5.4	6.0	8.10	6.14	0.23	0.10	6.47	1.64	0.74
14	464	5.4	6.0	8.10	6.39	0.24	0.10	6.73	1.38	0.62
18	483	5.4	6.0	8.10	6.56	0.24	0.10	6.91	1.20	0.54
24	511	5.4	6.0	8.10	6.81	0.26	0.10	7.17	0.94	0.42
28	526	5.4	6.0	8.10	6.94	0.26	0.10	7.31	0.80	0.36
34	546	5.4	6.0	8.10	7.12	0.27	0.10	7.49	0.62	0.28
54	587	5.4	6.0	8.10	7.47	0.28	0.10	7.86	0.25	0.11
64	607	5.4	6.0	8.10	7.64	0.29	0.10	8.03	0.07	0.03

[1] Average difference between feed box setting and actual amount of feed dispensed was +12%.
[2] Daily feed allocation, lb/d ×1.34 Mcal ME/lb of boar diet.
[3] 0.1823 Mcal ME/kg $BW^{0.665}$.
[4] 4.3 kcal/kg $BW^{0.75}$.
[5] 0.1 Mcal ME/d.
[6] Sum of ME requirements for maintenance, mating activity, and sperm production.
[7] Estimated energy intake - (Maintenance + Mating activity + Sperm production).
[8] Difference, Mcal ME/d ÷ 2.22 Mcal ME/lb.

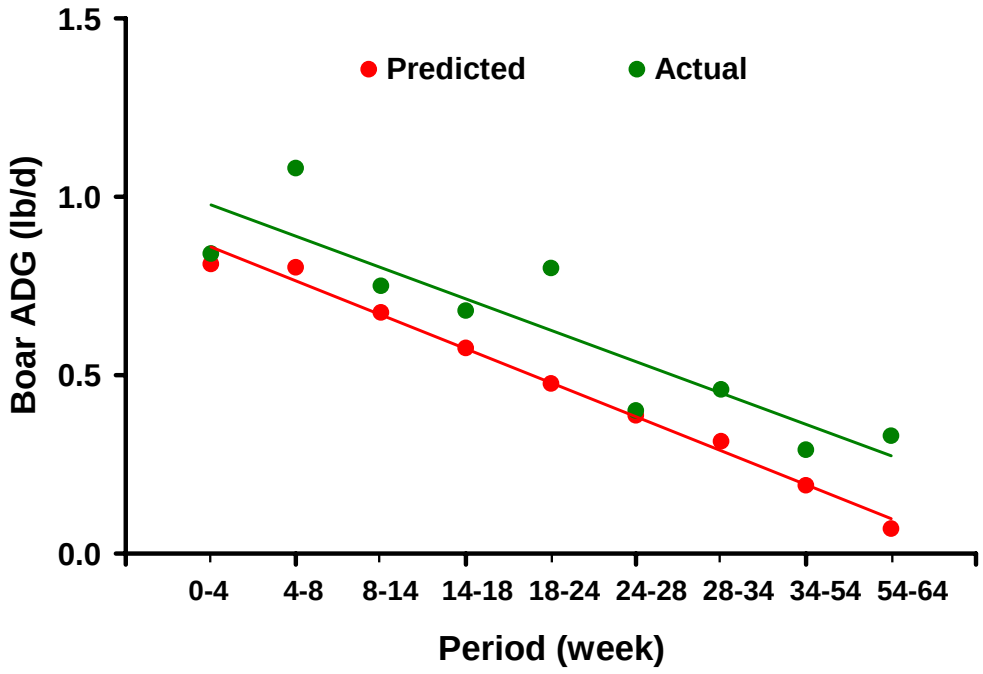

Figure 6. Predicted and actual daily weight gains (lb/d) of treatment boars.

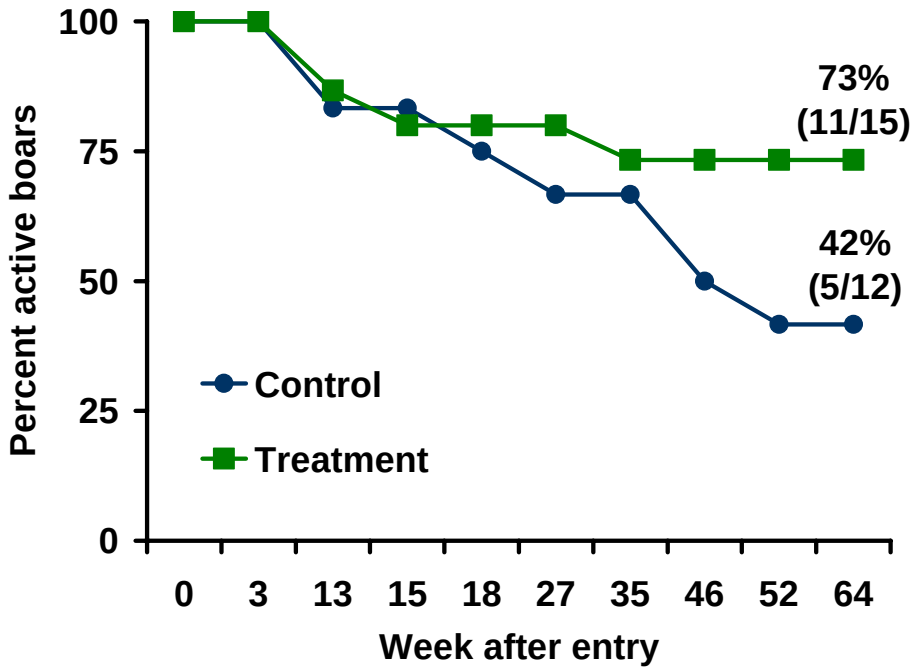

Figure 7. Effect of different feeding regimens on percentage of active boars in a commercial AI stud.
(Control = 6.7 lb/d for wk 0 to 8, then fed according to body condition, Treatment = 5.8 lb/d for wk 0 to 4 and then 6.0 lb/d until end of the study).

Table 3. Effect of different feeding regimens on semen production and longevity of adult working boars in a commercial AI stud[1]

Item	Feeding program[2]		SE	Probability, $P <$
	Control	Treatment		
No. of active boars				
Start of test	12	15	---	---
End of test	5	11	---	---
No. culled	7	4	---	---
Days in AI stud				
Total	3,345	5,173	---	---
Average	279	345	52.3	0.35
Semen collections				
Total	593	874	---	---
Average	49	58	7.9	0.41
Trashed collections				
Total	41	40	---	---
Average	3.4	2.7	1.0	0.59
% of Total	8.3	4.6	---	---
Doses produced				
Total	12,919	18,569	---	---
Average	1,077	1,238	226.0	0.60

[1] A total of 30 boars (initially 375 lb and 14.2 mo of age, PIC TR4) with 15 boars (replicates) per treatment; Control based on 12 boars because 3 early culls were untrainable for semen collections.

[2] Control feeding program = 6.7 lb/d for initial 8 wk then fed individual boars according to body condition; Treatment feeding program = 5.8 lb/d for initial 4 wk then fed all boars 6.0 lb/d for duration of the study.

Table 4. Effect of different feeding regimens on semen characteristics collected from adult working boars in a commercial AI stud[1]

Semen characteristics (average per ejaculate)	Feeding program[2]		SE	Probability, $P <$
	Control	Treatment		
Volume, mL	223	204	16.0	0.37
Doses produced	23	21	1.3	0.28
Sperm cells concentration, 1,000/mm^3	366	367	20.0	0.97
No. of sperm cells, $\times 10^9$	80	74	4.7	0.28
Motility, %	87.0	86.5	0.3	0.33
Normal cells, %	85.6	85.3	0.6	0.72

[1] A total of 30 boars (initially 375 lb and 14.2 mo of age, PIC TR4) with 15 boars (replicates) per treatment; Control based on 12 boars because 3 early culls were untrainable for semen collections.

[2] Control feeding program = 6.7 lb/d for initial 8 wk, then fed individual boars according to body condition; Treatment feeding program = 5.8 lb/d for initial 4 wk, then fed all boars 6.0 lb/d for duration of the study.