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Predicting growth rates of adult working boars in a commercial boar stud

Abstract

There is almost no information on ideal growth rates for adult boars, but estimates can be made if the relationship between boar weight and age is known. Therefore, this study was aimed to predict growth rates in adult working boars in a commercial boar stud. A total of 214 adult working boars from two genetic lines in a commercial boar stud were individually weighed on a platform scale. Age of the boar was recorded at the time of weighing. A regression equation to predict boar weight as a function of age was developed by using PROC REG of SAS. The model was used to predict BW on a daily basis, and ADG was derived as the difference between two predicted BW values. Factorial estimates of daily ME requirement and feeding rates were determined. The energy requirement for weight gain was computed by using the predicted ADG as a guide in setting target weight gains. Results showed a positive curvilinear response ($P<0.01$) to describe the relationship between boar weight and age. Predicted ADG decreased in a curvilinear manner as the boars aged. In conclusion, on-farm growth rates can be predicted effectively by relating weight with age, taken from a representative number of boars in a given farm population. These data can then be used to develop farm specific feeding programs or to set different growth curves for experimental purposes.; Swine Day, 2006, Kansas State University, Manhattan, KS, 2006

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PREDICTING GROWTH RATES OF ADULT WORKING BOARS IN A COMMERCIAL BOAR STUD

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Summary

There is almost no information on ideal growth rates for adult boars, but estimates can be made if the relationship between boar weight and age is known. Therefore, this study was aimed to predict growth rates in adult working boars in a commercial boar stud. A total of 214 adult working boars from two genetic lines in a commercial boar stud were individually weighed on a platform scale. Age of the boar was recorded at the time of weighing. A regression equation to predict boar weight as a function of age was developed by using PROC REG of SAS. The model was used to predict BW on a daily basis, and ADG was derived as the difference between two predicted BW values. Factorial estimates of daily ME requirement and feeding rates were determined. The energy requirement for weight gain was computed by using the predicted ADG as a guide in setting target weight gains. Results showed a positive curvilinear response ($P<0.01$) to describe the relationship between boar weight and age. Predicted ADG decreased in a curvilinear manner as the boars aged. In conclusion, on-farm growth rates can be predicted effectively by relating weight with age, taken from a representative number of boars in a given farm population. These data can then be used to develop farm-specific feeding programs or to set different growth curves for experimental purposes.

(Key Words: Boars, Growth Rate, Prediction Equations.)

Introduction

Weight gain is inevitable in breeding boars because they enter the boar stud at a young age and light weight. It is typical for working boars to start their reproductive life between 300 and 350 lb, and gain more than 250 lb throughout their lifetime. The relationship between growth rate and reproductive performance of breeding boars may be important. In previous studies, slow-growing boars fed at maintenance have shown significantly decreased libido, semen volume, and sperm output. On the other hand, fast-growing boars fed at high rates are thought to have increased leg and libido problems. Rate of weight gain may also have an impact on longevity, and thus affect lifetime semen production. But the ideal growth rate for adult working boars remains unclear. This lack of information on growth rates of adult boars during their lifetime is a major challenge, but estimates can be made if the relationship between body weight and age of the boar is known. Moreover, predicting growth rates can be very helpful in developing

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appropriate feeding programs that can be used to set different growth curves. Therefore, this study aimed to predict growth rates in adult working boars in a commercial boar stud.

Procedures

A total of 214 adult working boars from two genetic lines (180 TR4 and 34 L-380 PIC, Franklin, KY) were used in this study. Boars were selected to obtain the widest possible range in age and weights. Boars were individually weighed on a platform scale, and age of the boar was recorded at the same time. Boars were fed and housed in a commercial boar stud according to standard procedures of the farm. Diets were not manipulated for this study. All boars were fed a corn-soybean meal diet with 10% soy hulls and 5% dehydrated alfalfa, formulated to meet or exceed suggested lysine and energy requirements.

A regression equation to predict boar weight by using age of the boar was developed by using PROC REG of SAS. This model was used to predict BW for a specific age on a daily basis. Then, ADG was derived as the difference between consecutive predicted BW values. The ADG for a specific weight range is computed by taking the average of the predicted ADG of the lowest and highest value of the weight range desired.

Daily ME requirement (Mcal ME/d) and feeding rates (lb/d) under thermoneutral conditions were estimated by using the factorial approach. Requirements for maintenance, weight gain, mating activity, and sperm production were individually determined by using regression equations, and were added to estimate total daily ME requirement. The energy requirement for weight gain was determined by using the predicted ADG as a guide in setting target weight gains. The accuracy of feed drops in the facility was previously tested, and an average of 12% overage from the desired feed setting was determined. This was then used to adjust the feed box setting to obtain the desired feed allocation for each weight range. Finally, a phase-feeding program for adult working boars was developed from the estimates for daily ME requirement.

Results and Discussion

The modeled live-weight curve in boars as a function of age exhibited a positive curvilinear response ($P<0.01$; Figure 1). The model was:

$$\text{BW, lb} = [(8 \times 10^{-7} \times \text{Age}^3) - (0.0023 \times 10^{-2} \times \text{Age}^2) + (2.2561 \times \text{Age})] - 63.1$$

The predicted BW increased from 330 to 642 lb from an age of 220 to 620 d; that is an 80 lb increase for every 100 d. But the increase in BW decreased dramatically to a total of 50 lb from 620 to 1000 d of age. The developed equation was used to derive ADG from the predicted BW, and showed a negative curvilinear response as the boars aged (Figure 2). Predicted ADG decreased from 1.24 lb/d at 350 lb to 0.12 lb/d at 700 lb (Table 1). There are very few studies evaluating boar growth, but scientists from the Netherlands combined experimental and field data, and suggested a growth rate of 1.10, 0.88, 0.66, 0.44, 0.22, and 0.11 lb/d for boars weighing 330, 440, 550, 660, 770, and 880 lb, respectively. In this study, predicted ADG was 23, 20, and 6% higher than the Dutch recommendations at 330, 440, and 550 lb, respectively (Table 2). At 660 lb, the predicted ADG was 50% less than the Dutch recommendations.

Table 1. Predicted ADG for Adult Working Boars

BW, lb		Predicted ADG
Initial	Final	lb/d
350	400	1.24
400	450	1.10
450	500	0.95
500	550	0.79
550	600	0.61
600	650	0.40
650	700	0.12

Table 2. Comparison of Predicted ADG with Dutch Recommendations

BW		Recommended ADG, lb/d		
lb	kg	Dutch Study[1]	Current Study	% difference
330	150	1.10	1.36	+ 23%
440	200	0.88	1.06	+ 20%
550	250	0.66	0.70	+ 6%
660	300	0.44	0.22	- 50%
770	350	0.22	-	-
880	400	0.11	-	-

[1]Kemp and Soede, 2001.

There may be a number of reasons that can explain the differences in growth rates, such as genetic, dietary, environmental, and even procedural differences, but the predicted ADG in this study is similar to the Dutch recommendations. This may indicate that relating BW and age of an appropriate sample of boars from a given farm population can be a practical method in predicting on-farm growth rates. This agrees with previous research at Kansas State University in finishing pigs, in which real-time ultrasound scans of backfat and longissimus muscle area across different age groups of pigs were used effectively to determine daily protein and lipid accretion rates. Therefore, the data-collection method described herein can be employed to either determine farm-specific nutrient requirements or to develop appropriate feeding programs.

As an example, a phase-feeding program for adult working boars was developed from the predicted growth rates in this study. Factorial estimates of daily ME requirement and feeding rate were made for adult working boars from 300 to 700 lb (Table 3). The target values for weight gain indicated that the energy requirement for growth decreased from 2.89 to 0.44 Mcal ME/d as growth rate decreased from 1.30 to 0.20 lb/d at 300 and 700 lb, respectively. But daily energy needs of boars increased from 7.94 Mcal ME/d at 300 lb to 9.27 Mcal ME/d at 700 lb. At a dietary energy concentration of 1.4 Mcal ME/lb, the calculated daily feed allowance was 6.1, 6.3, 6.5, and 6.7 lb/d at 300 to 400, 400 to 500, 500 to 600, and 600 to 700 lb, respectively. This feed allocation provided 8.2, 8.4, 8.7, and 9.0 Mcal ME/d. These represented the four phases of the proposed feeding program. The daily ME intake of boars in the phase-feeding program fitted well with their daily ME requirement (Figure 3). Finally, the feed allocation was adjusted according to the accuracy of feed drops in the farm. An average of 12% overage from the desired feed setting was determined, and this was accounted for in the final feed allocation. The proposed phase-feeding program in boars, with the appropriate adjustments in feed allocation, is shown in Table 4.

In conclusion, relating age and body weights of boars in a given farm population can be an efficient and accurate method to model on-farm growth and predict growth rates. These data can then be used to develop farm-specific feeding programs or to set different growth curves for experimental purposes.

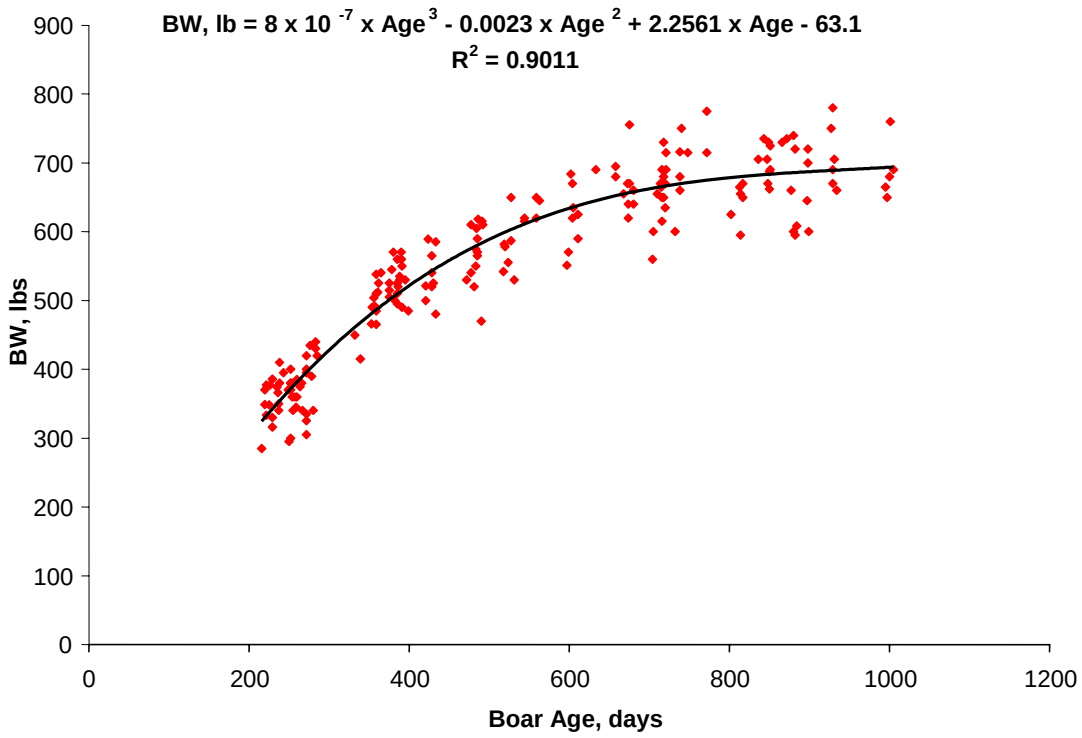

Figure 1. Relationship of Boar Age and Body Weight (214 boars).

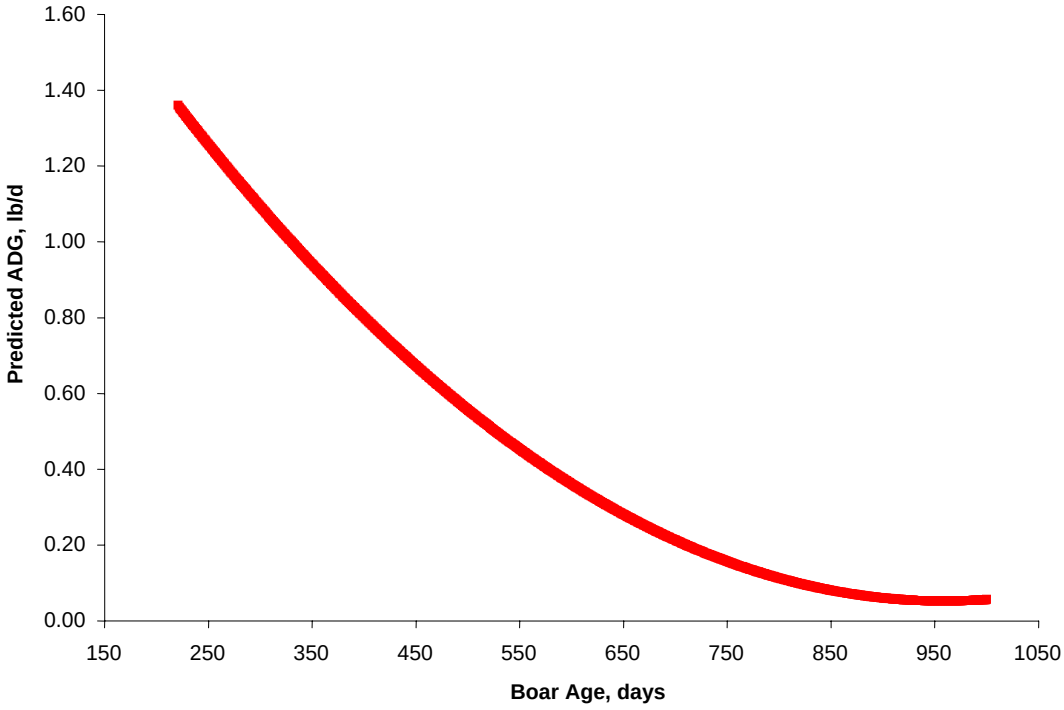

Figure 2. Predicted ADG of Adult Working Boars from 220 to 1000 d of Age.

Table 3. Daily ME Requirement (Mcal ME/d) and Feed Allowance (lb/d) for Adult Working Boars under Thermoneutral Conditions

Phase	BW	Maintenance[1]	Weight Gain[2]		Mating Activity[3]	Sperm Production[4]	Total ME Requirement	Daily Feed Allocation[5]		Feed Box Setting[6]
	lb	Mcal ME	Target, lb/d	Mcal ME	Mcal ME	Mcal ME	Mcal ME/d	lb/d	Mcal ME/d	lb/d
1	300	4.78	1.30	2.89	0.17	0.1	7.94	6.1	8.2	5.3
	340	5.20	1.20	2.66	0.19	0.1	8.15	6.1	8.2	5.3
	375	5.55	1.10	2.44	0.20	0.1	8.29	6.1	8.2	5.3
2	400	5.79	1.00	2.22	0.21	0.1	8.32	6.3	8.4	5.5
	430	6.08	0.90	2.00	0.22	0.1	8.40	6.3	8.4	5.5
	455	6.31	0.85	1.89	0.23	0.1	8.53	6.3	8.4	5.5
	480	6.54	0.80	1.78	0.24	0.1	8.66	6.3	8.4	5.5
3	500	6.72	0.70	1.55	0.25	0.1	8.62	6.5	8.7	5.7
	520	6.90	0.65	1.44	0.26	0.1	8.70	6.5	8.7	5.7
	540	7.07	0.60	1.33	0.27	0.1	8.77	6.5	8.7	5.7
	560	7.24	0.50	1.11	0.27	0.1	8.73	6.5	8.7	5.7
	575	7.37	0.50	1.11	0.28	0.1	8.86	6.5	8.7	5.7
	590	7.50	0.40	0.89	0.28	0.1	8.77	6.5	8.7	5.7
4	600	7.58	0.40	0.89	0.29	0.1	8.86	6.7	9.0	5.9
	620	7.75	0.30	0.67	0.30	0.1	8.81	6.7	9.0	5.9
	640	7.92	0.20	0.44	0.30	0.1	8.76	6.7	9.0	5.9
	660	8.08	0.20	0.44	0.31	0.1	8.93	6.7	9.0	5.9
	680	8.24	0.20	0.44	0.32	0.1	9.10	6.7	9.0	5.9
	700	8.40	0.20	0.44	0.32	0.1	9.27	6.7	9.0	5.9

[1]Maintenance = 0.1823 Mcal ME/kg $BW^{0.665}$.
[2]Weight gain = 2.22 Mcal ME/lb x target weight gain, lb.
[3]Mating activity = 4.3 kcal/kg $BW^{0.75}$.
[4]Sperm production = 0.1 Mcal ME/d.
[5]Diet energy used in calculating feed allocation was 1.4 Mcal ME/lb.
[6]Feed box setting = daily feed allocation, lb/d - (daily feed allocation, lb × 12% overage).

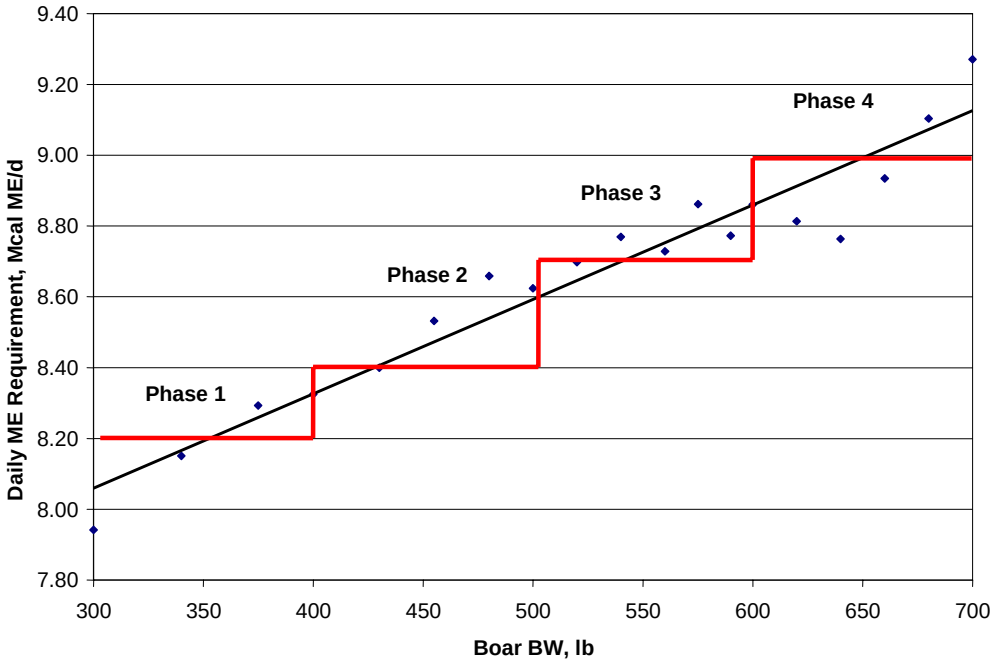

Figure 3. Relationship of Daily ME Intake (Mcal ME/d) and ME Requirement (Mcal ME/d) in Adult Working Boars under a Phase-feeding Program.

Table 4. Phase-feeding Program Developed for Adult Working Boars in a Commercial Boar Stud on the Basis of Predicted Growth Rates

Phase	BW, kg		Feed Allocation	Feeding Duration
	Initial	Final	lb/d	mo.
1	300	400	5.3	3
2	400	500	5.5	4
3	500	600	5.7	6
4	600	700	5.9	>12