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Estimation of body weight in Nguni-type cattle under communal management conditions

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Introduction

Body measurements of beef cattle are used for several purposes, including prediction of growth rate, body condition, conformation and carcass traits (Brown *et al*., 1973; Gosey, 1984; Doren *et al*., 1989; Wilson *et al*., 1997). Although, live weight (LW) is an important economic trait in beef cattle, it is seldom measured in rural communal areas due to lack of scales. Bhadula *et al*., (1979) indicated that the best method of weighing animals without a scale is to regress LW on certain body measurements that can be measured readily. The objective of this study was to derive prediction equations for LW and scrotal circumference (SC) using heart girth (HG) and wither height (WH).

Material and Methods

Various body measurements were collected from predominantly Nguni-type cattle at Muledzhi communal dipping tank, located 50 km north of Thohoyandou. Data were collected from September to December 1999. A total of 879 animals were measured, constituting, 862 LW, 725 HG, 732 WH, 763 condition scores (CS) and 140 SC. Correlation coefficients between LW and other body measurements were determined within sex, age and months groups. Regression of LW and SC on each of the independent variables was performed using the regression analysis procedure of SAS (1989). Linear, quadratic and cubic effects of the independent variables were considered. Also, LW and SC were regressed to the combination of HG and WH. The general model used was:

$$Y_i = b_0 + b_1 X_i + b_2 X^2_i + b_3 X^3_i + e_i$$

Where: Y_i = LW and SC observation I;
b_0 = Intercept;
b_1, b_2, b_3 = Corresponding linear, quadratic and cubic regression coefficients;
X_I = Body measurements i (HG, WH);
e_I = Residual error term.

Results and Discussion

Correlation coefficients for body measurements between sex groups are shown in Table 1. Within the male group LW had the highest correlation with HG, with the lowest value being that for CS. The same can be said within the female group. In contrast, SC was highly correlated to WH but uncorrelated with CS. Similar trends were observed when the age groups were categorized from one-year heifers to cows older than five years.

Table 1 Correlation coefficients (number of observations) for body measurements between sex groups

	HG	WH	CS	SC
Males				
LW	0.76 (252)	0.51 (258)	0.47 (295)	0.60 (101)
SC	0.58 (96)	0.61 (99)	0.28 (102)	
Females				
LW	0.62 (462)	0.48 (461)	0.23 (560)	

LW: Live weight; HG: Heart girth; WH: Wither height; CS: Condition score; SC – Scrotal circumference.

Regression equations developed to predict LW and SC are indicated in Table 2. When LW and SC were estimated using HG and WH, adjusted R^2 was the lowest (LW_1, LW_6, SC_1 & SC_6). Using linear HG and WH in combination had 0.02 (LW_2) and 0.03 (SC_2) improvements to R^2 as compared to the linear models. The best predictor models seem to be the third degree polynomials in combination with a linear measure of the other trait (LW_5, LW_9, SC_5 & SC_9).

Table 2. Regression equations for predicting LW & SC in Nguni-type cattle using HG and WH.

MODEL	Intercept	Linear	Combination	Quadratic	Cubic	Adj. R^2
LW_1	16.58	0.81 HG	-	-	-	0.74
LW_2	-166.41	0.56 HG	2.26 WH	-	-	0.76
LW_3	69.49	0.41 HG	-	$6.7x\ 10^{-4}\ HG^2$	-	0.75
LW_4	44.87	0.70 HG	-	$3.0x\ 10^{-4}\ HG^2$	$9.0 \times 10^{-7}\ HG^3$	0.75
LW_5	-158.00	0.11 HG	2.87 WH	$4.0x\ 10^{-4}\ HG^2$	$5.0 \times 10^{-7}\ HG^3$	0.78
LW_6	-480.00	6.47 WH	-	-	-	0.69
LW_7	993.07	-20.85 WH	-	$0.13\ WH^2$	-	0.78
LW_8	991.00	-20.79 WH	-	$0.12\ WH^2$	$1.0 \times 10^{-6}\ HG^3$	0.76
LW_9	-225.52	10.93 WH	0.34 HG	$-0.14\ WH^2$	$7.0 \times 10^{-4}\ HG^3$	0.78
SC_1	18.23	0.03 HG	-	-	-	0.38
SC_2	1.15	0.01 HG	0.21 WH	-	-	0.41
SC_3	13.90	0.06 HG	-	$-5.0 \times 10^{-5}\ HG^2$	-	0.40
SC_4	4.22	0.18 HG	-	$4.5 \times 10^{-4}\ HG^2$	$4.0 \times 10^{-7}\ HG^3$	0.42
SC_5	-7.79	0.15 HG	0.17WH	$-4.0 \times 10^{-4}\ HG^2$	$4.0 \times 10^{-7}\ HG^3$	0.44
SC_6	-3.73	0.28 WH	-	-	-	0.41
SC_7	-11.28	0.42 WH	-	$-6.4 \times 10^{-4}\ WH^2$	-	0.41
SC_8	-22.87	0.73 WH	-	$-3.5 \times 10^{-3}\ WH^2$	$8.4 \times 10^{-6}\ WH^3$	0.40
SC_9	-84.42	2.34 WH	0.02 HG	$-0.017\ WH^2$	$4.0 \times 10^{-5}\ WH^3$	0.41

LW_1: Live weight model 1; SC_1: Scrotal circumference model 1; HG: Heart girth; WH: Wither height

Heart girth exhibited the highest correlation with LW and SC. It was evident that third degree polynomial equations showed little benefit in predicting LW and SC, as reflected in the small increases in R^2. Other studies (Heinrichs et al., 1992; Wilson et al., 1997) also reported little benefit of third degree polynomials. Models developed were better estimators of LW as compared to SC.

Conclusion

In circumstances which do not allow the use of a scale, as is the case in rural areas, HG and WH can be used to estimate LW and SC.

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