Short Communications / Kort Mededelings

Heritability estimates for different Kleiber ratios obtained from growth performance data in a Hereford herd

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Heritability estimates for Kleiber ratios associated with growth were obtained for a Hereford stud, subjected to selection for growth over an 11-year-period. Heritability estimates obtained indicate that growth efficiency in terms of the Kleiber ratio is moderately heritable.

Erflikheidsramings vir verskillende Kleiberverhoudings is bereken van data afkomstig van 'n Herefordstoetkudde, waar geselekteer is vir groei oor 'n periode van 11 jaar. Waardes bereken vir oorerflikhede toon aan dat groeidoeltreffendheid, gemeet met behulp van Kleiberverhoudings, matig oorerflik is.

Keywords: Hereford cattle, heritability, Kleiber ratio.

The Kleiber ratio is a measurement for efficiency, independent of body size (Kleiber, 1961). This ratio, defined as growth rate/body mass^{0,75}, was suggested for measuring growth efficiency (Kleiber, 1947). It was indicated by Scholtz *et al.* (1990) that the Kleiber ratio, expressed as postweaning ADG/mature mass^{0,75}, could be used as an indirect selection parameter for feed conversion.

The purpose of this study was to obtain heritability estimates for the Kleiber ratio at different stages of growth. Data were used from a Hereford stud herd, subjected to selection for growth over a period of 11 years. Data included the following performance traits: birth mass, 100-day-, 205-day-, 365-day- and 540-day-mass. The increases in mass for the different ages namely 100 days, 205 days, 365 days and 540 days were used in the calculations for average daily gain. These were used to calculate Kleiber ratios from birth to 205 days, birth to 365 days, birth to 540 days, as well as for the growth periods between 205–365 days and between 205–540 days.

Year, age of dam and sex of animal were investigated as possible fixed effects. Calves were born almost throughout the year; therefore year was divided into two seasons, namely August to December and January to July. A new factor called year-season was thereby created. Age of dam classes were restricted to first calves (heifers) and cows. For the Kleiber ratios mentioned above only year-season and sex of animal were found to be significant ($P < 0.01$).

Heritability estimates were obtained using the library program LSMLMW (Harvey, 1988). The following model was fitted:

$$Y_{ijkl} = \mu + YS_i + s_j + b_k + e_{ijkl}$$

where Y_{ijkl} = the record(s) on the l^{th} individual of the k^{th} sire, j^{th} sex and born in the i^{th} year-season,

μ = population mean,

YS_i = the fixed effect of the i^{th} year-season where $i = 1-26$,

s_j = fixed effect of the j^{th} sex of animal, where $j = 1$ or 2,

b_k = the random effect of the k^{th} sire, and

e_{ijkl} = random error.

The heritability estimates obtained for the various Kleiber ratios (KL) are shown in Table 1.

Table 1 Heritability estimates (h^2) for Kleiber ratios (KL)

Trait	h^2	n
KL: birth to 205 days	0.218 ± 0.087	853
KL: birth to 365 days	0.543 ± 0.136	773
KL: birth to 540 days	0.419 ± 0.165	437
KL: growth 205–365 days	0.225 ± 0.096	773
KL: growth 205–540 days	0.431 ± 0.169	437

Heritability estimates of Kleiber ratio for preweaning growth were reported by Badenhorst *et al.* (1991), Van Wyk *et al.* (1993) and Bergh (1990) as 0.116 ± 0.054 (sheep), 0.137 ± 0.027 (sheep), and 0.309 ± 0.126 (cattle), respectively. This is comparable with the estimate of 0.218 ± 0.087 found in this study. Heritability estimates of Kleiber ratios from birth to 365 days and 540 days could not be verified from available literature. Kleiber ratios for postweaning growth measured between 100 and 365 days for sheep were reported by Badenhorst *et al.* (1991) as 0.231 ± 0.070. Bergh (1990) indicated a heritability estimate for the Kleiber ratio of 0.492 ± 0.153 for growth between 205 and 540 days for cattle. Both estimates are similar to h^2 estimates for the Kleiber ratio reported in the present study. According to these estimates, it seems that growth efficiency in terms of the Kleiber ratio is moderately heritable and that the Kleiber ratio could be applied in selection for increasing the efficiency of growth.

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A note on the evaluation of a simulation program for beef cattle breeding and production

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The aim of the study was to evaluate results obtained from a computer simulation program (Vleissentraal Simulation Program for a Beef Production System). Simulation runs were carried out and the results were compared with published, scientifically proven results. The results obtained by simulation were found to be in the same numeric order as those used for comparison. This satisfies the need for model validation based on scientifically correct hypotheses. It can be concluded that the program is suitable for further studies.

Die doel van die studie was om die resultate van 'n rekenaarsimulasieprogram ('Vleissentraal Simulation Program for a Beef Production System') te evalueer. Simulasie-lopies is gedoen en resultate is vergelyk met gepubliseerde, wetenskaplik-korrekte resultate. Resultate was in dieselfde numeriese orde as dié wat vir vergelyking gebruik is. Dit verskaf genoegsame getuienis dat die program voldoen aan wetenskaplik-gefundeerde hipoteses. Die gebruik daarvan in verdere studies is derhalwe aanvaarbaar.

Keywords: Beef cattle, simulation.

When designing breeding programmes we consider how present actions are likely to affect future selection responses, performance and economic returns (William & Hill, 1986). Experimental evaluation of breeding and production systems is complicated by tremendous cost in both time and money. Such limitations can partially be overcome by using mathematical computer simulation models to simulate livestock breeding and production systems (Long *et al.*, 1975). The quantitative nature of animal breeding facilitates such computer modelling in many disciplines within agriculture and for a variety of purposes (Long *et al.*, 1975; Dent & Blackie, 1979). One of the areas suggested as being worthy of such an approach is the definition of bioeconomic objectives (Harris & Stewart, 1986).

Bioeconomic simulation models are crucially needed for animal production (Hohenboken, 1986). The development and validation of models which are suitable for each major production, climatic and managerial environment, were fuelled by the use of appropriate biological and economic inputs and also by the desire to integrate available genetic and economic information into a comprehensive computer simulation program for breeding purposes. Development of adequate models for simulation of any system requires accurate estimates of all parameters (Long *et al.*, 1975). Output variables alone are not sufficient, and therefore input variables should also be taken into consideration. Dent & Blackie (1979) stated that the requirement of the user for assessment will govern the type of testing most appropriate for a particular model. Bearing this in mind, it was decided to test the validity of the model under consideration against results from a mathematical approach published by Roux (1992). Roux's results are in reasonable agreement with results of a simulation study by Notter *et al.* (1979) as well as experimental results which formed the basis of the mathematical approach by Taylor *et al.* (1985).

The model evaluated is 'The Vleissentraal Simulation Program for a Beef Production System'. It is based on a typical Bushveld farm situation, but makes provision for changes to variables in order to allow evaluation of other farm types. The tables of Meissner (1982) which give the definition of a large stock unit and large stock unit equivalents of various classes of stock, were used in the development of this simulation program. Technical aspects, assumptions, arguments and comprehensive data used to establish the realistic and scientific accountable tables were published by Meissner (1982). Information supplied by this program is summarized in Table 1. It is important to note that costs mentioned in this table are strictly applicable to the biological system involved and do not include fixed costs. The program also allows for changes in breeding herd structure, marketing strategy, supplementary feeding program and many other factors. Du Toit (1993) can be consulted for a complete printout and more information on results obtained by the use of the program. The aim is, however, to use this model to predict the variation in both biological output and economic return for the different beef breeds, performance traits and production systems. The same assumptions made by Roux (1992) to compare his mathematically deducted results to other studies by Taylor *et al.* (1985) and Notter *et al.* (1979) were used in this comparison.

Data used in this simulation study are the national averages for beef cattle obtained from the National Beef Cattle Performance and Progeny Testing Scheme for the period 1980–1985.