GENETICS OF GROWTH IN MICE WITH PARTICULAR REFERENCE TO THE APPLICATION OF NONLINEAR MODELS

by

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THESIS SUMMARY

The primary aim of this study was to examine the ability of nonlinear models to describe the weight/age and feed intake/age growth patterns in mice. The objective underlying this examination was to investigate the possibility of utilising the parameters of these models as selection criteria to alter the shape of the growth curves. In association with this primary aim an investigation of the interrelationships between growth, feed intake and the efficiency of growth was undertaken.

Phenotypic and genetic analyses for weight, measures of growth rate, fraction of maturity, feed intake and feed efficiency were presented. Marked differences were found for some estimates of heritabilities, genetic and phenotypic correlation when compared with those reported for other studies on mice. A possible explanation, in terms of the differences in fractions of maturity when comparisons are made at similar ages, was proposed. Heritabilities tended to decrease with age for all measures of growth that were considered. Predicted direct and correlated responses to selection for a single generation were examined and the results obtained were consistent with predictions from two genetic models of growth proposed in the literature.

Five nonlinear models were excluded from detailed analyses because of their inability to consistently provide adequate fits to

the data. These were the generalised Richards' function and the two parameterisations of the Brody and Bertalanffy functions. The seven remaining models, the three Parks' functions and two parameterisations of the Gompertz and Logistic models, were examined in detail. Genetic and phenotypic analyses showed that there was considerable variation for the parameters of each model type. Results from a simulated selection experiment based on parameters of the Parks' functions were examined. Responses obtained suggested that selection on a single parameter or parameter set would produce changes in the growth curves for the mouse population studied. However, it was concluded that results would be unlikely to produce curves that could, in domestic species, represent economically desirable growth patterns.

An examination of the role of maternal effects on growth, feed intake, feed efficiency and the parameters of the nonlinear models found significant genetic covariances between maternal and additive genetic effects. It was suggested that the rate parameters of the seven models, k, t* and (AB), were most severely affected by the maternal genetic and environmental influences. Results obtained from the cross-fostering experiment, for growth, were consistent with similar studies on mouse populations.

A detailed examination of the distributional and statistical properties of the models and their parameters estimates was undertaken. The results presented suggested that all models showed some degree of non-normal behaviour. Parameter estimates obtained exhibited both skewed and leptokurtic distributions for the popu-

lation studied. Estimates of biases in parameters estimates obtained either by simulation or calculated from the fitting process showed the parameters of the Parks' functions to be highly biased. A possible explanation for these highly biased estimates was suggested in terms of the model parameterisations and the range of data points to which the models were fitted. The generalised Logistic function was suggested as providing the best fit to the data based on the statistical and distribution criteria discussed. The Parks' models provided the most information on growth from the point of view of the biological interpretations that could be placed on the parameters.

It was concluded that the parameters of nonlinear models could be used as alternative selection criteria to alter the shape of the growth patterns for mice and possibly domestic livestock species. However, the large amount of data necessary to make accurate predictions on growth, the statistical problems associated with fitting different models and the requirement of an estimate of mature weight prior to selection may make utilising parameters of nonlinear models as selection criteria an unviable proposition.