SELECTION AND MATING STRATEGIES
RISKS AND REWARDS

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Certificate

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

Signature

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Abstract

Best Linear Unbiassed Prediction provides a valuable mechanism through which effective selection practices can operate, potentially enhancing performance and producing significant increases in productivity and thus, frequently in profitability. However, current recognition of the potential risks associated with this enhanced performance through the impacts of risks such as inbreeding depression, offer a challenge to the effectiveness with which selection can operate.

The broadening of the selection objective to address issues of risk in the selection process as described in this thesis integrates genetic objectives with economic perspectives. This is addressed through several areas. An initial consideration of this impact of accuracy in the selection process is undertaken from a single generational perspective. Longer term selection is addressed through the analysis of a range of selection and mating strategies including mate selection strategies that integrate increased genetic merit with the control of inbreeding (or similar risk factors). An assessment of long term strategies is undertaken through an adapted use of benefit cost methodology.

Accuracy in Selection

A stochastic simulation was carried out to investigate the impact of using an index of ebvs and accuracy on genetic response and utility. Two population types were considered based on the range of accuracy used (Type A: 0 - 1.0 and B: 0.5 - 1.0). Five hundred replications were carried out leading to the evaluation of the sample mean response and its variance. The index weightings defining plateax within 1% and 5 % of the maximum response were identified, these suggesting that for population types A and B, minimal loss in response will occur if weightings on accuracy of up to

$\pm 0.5\sigma$ and $\pm 1.5\sigma$ are selected (where σ is the standard deviation of the true breeding value). These weightings result in relatively minor changes in the rankings of animals, particularly where only a small number of animals are selected. Utility was defined as a function of the mean and variance of the sample response.

The index weightings leading to the maximal utility were identified for seven utility functions (three risk averse, three risk preferring and one risk neutral function). Placing some weight on accuracy when making selection decisions can be done with little compromise in expected mean response. This gives the opportunity to reflect risk preferring or risk averse attitudes through the use of negative or positive weightings on accuracy. However, it seems that somewhat extreme utility functions are required before this opportunity can result in significant benefit.

Mate Selection Strategies

Stochastic simulation was used to evaluate a range of selection strategies with respect to both additive genetic response and inbreeding. Strategies involving selection on BLUP ebvs or individual phenotype, followed by random mating, were compared with mate selection which used portfolio analysis to give joint consideration to genetic merit and inbreeding. An adapted Mean Of Total Absolute Deviations (MOTAD) method was used in a mate selection model to define optimal matings with regard to aggregate genetic merit and inbreeding for a base population h^2 of 0.2. Compared with random mating following selection on BLUP ebvs, inbreeding levels after 10 years of selection were able to be reduced under BLUP plus mate selection from ~0.23 to as little as 0.11. Additive genetic gain was either little compromised or increased.

The results suggest that information linking expected levels of genetic merit and inbreeding can be used to find the preferred selection strategy.

Benefit Cost Assessment

The Benefit Cost approach provides an effective mechanism through which the comparison of selection strategies for multiple objectives measured over an implementation period can be undertaken.

The strategies were compared across a range of weightings on inbreeding (linked to decline in response). The results showed a preference for MS_0 (a mate selection option with no loss in response) over the selection and mating strategy (P_r) - however this preference was mediated when the additional cost of managing mate selection was taken into account and the weighting on inbreeding was low. Interestingly, the relative value of the MS_5 strategy was seen across all alternatives. This marked a reasonable point at which the benefits from reduced inbreeding might outweight the costs associated with some decline in potential response.

While this analysis was undertaken for two levels of interest rate (0.6 and 1.0) and for two variations in the model, with one including an additional weighting on mate selection strategies to reflect the additional management costs they impose, the final results were not highly sensitive to these factors, indicating the strength of this approach for this assessment.