A BREEDING OBJECTIVE AND SELECTION INDEX PACKAGE FOR USE WITH BREEDPLAN

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INTRODUCTION

B-OBJECT is a micro-computer package developed at the Animal Genetics and Breeding Unit to help breeders establish and evaluate breeding directions and make better use of BREEDPLAN EBVs. It is both a mechanism for introducing formal objectives to the beef industry and a means for simplifying multi-trait selection. B-OBJECT can be used by bull breeders and bull buyers for establishing the relative emphasis or weighting to place on the EBVs available for use in selection, and to rank animals for their overall breeding value for a given type of commercial production system and market. It can also be used to predict ahead what genetic changes will occur in a herd if a particular set of weightings are applied to selection of the herd, to compare alternative selection strategies, and for testing how sensitive any strategy is to a change in market requirements or prices.

In the beef industry, there have been major advances in the methods of genetic evaluation, via BREEDPLAN, but little corresponding advance in how best to target the genetic improvement effort. Breeders are still forced to make only intuitive decisions about the relative importance of different attributes (e.g., growth rate, scrotal size, structural soundness, eye pigmentation etc.), and on the extent to which these are genetically related (e.g., whether increasing growth rate will have an effect on dystocia, or greater muscling an effect on fertility etc.). B-OBJECT is designed to help breeders make these decisions more objectively and simply.

APPLICATIONS

Formally, the breeding objective is a description of the balance needed between traits for maximum profitability, just as BREEDPLAN utilises a description of inheritance in calculating the EBVs for birth weight, 600-day weight, scrotal size, ease of calving, fat depth, and so on. Establishing the breeding objective is a key step towards answering a number of major industry issues. For instance, the industry is concerned with 'breeding for profitability', but how can this be achieved at the genetic level ? There is also interest in breeding 'balanced' cattle rather than breeding for extremes. What is the balance of traits needed and how does this vary for different situations ? An explicitly defined objective also allows issues such as how to breed for targeted markets, and how to evaluate the potential of additional recording (e.g. Barwick et al. 1992) to start to be addressed.

A further factor encouraging clearer objectives is the growing availability of BREEDPLAN EBVs (Schneeberger et al. 1991). What emphasis should be placed on each if the goal is to breed for profitable beef production ? After assisting in defining the objective, B-OBJECT produces the most appropriate combination of the available EBVs to use in selection for the defined objective. Note that B-OBJECT allows the user's own assessment of the required balance of traits to be developed and utilised, on a

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customised basis. This facility recognises both that the Australian beef industry involves a vast diversity of breeds, breeding and production systems, environments and markets, and that breeders need a strong sense of ownership of any objective if they are to pursue it (Upton et al. 1988).

Potential users are considered to include:

* Bull breeders - As a selection aid, utilising the most appropriate single genetic ranking and using this in association with other culling criteria; and as a marketing aid, providing separate rankings for different individual clients or types of clients.

* Bull buyers (individual buyers or buyers grouped according to their type of beef enterprise) - As a buying aid, utilising the most appropriate ranking of available bulls for the required production system and targeted market.

* Industry consultants - To help match bull-buying clients with available sale bulls; and as an aid for both bull-breeding and bull-buying clients.

* Breed societies and other users of GROUP BREEDPLAN - To promote bulls, and breeding practices, for specialised functions or for versatility over several beef production systems and markets.

Ultimately, the whole industry might be expected to benefit through enhancement of the capacity to target breeding at the production of beef for specific markets.

COMPONENTS OF THE PROCEDURE

B-OBJECT involves 3 key inputs:

1. Breeder-supplied production and cost estimates for commercial beef production. These allow assessment of the breeder's required balance between traits, i.e. the breeding objective.

2. The measurements or EBVs available to a breeder through BREEDPLAN.

3. A description of the inheritance of all traits concerned, including the genetic correlations between all traits and measurements, i.e. the so-called 'covariance structure'. Note that use of a covariance structure allows correlated information to be utilised in the same way that BREEDPLAN uses the heritabilities of measures and correlated information to produce EBVs.

The result from using the procedure is an aggregate EBV, the $Index-EBV, which is the best index of measurements to use to breed for the required balance of traits. Note the importance of not confusing the traits to be improved (e.g. female fertility) with those which are just measurements (e.g. scrotal size) providing information about the economically important traits. This hasn't been a problem while BREEDPLAN has dealt only with weights, but with the addition of further EBVs to BREEDPLAN the distinction between traits and measurements is less clear. The index takes the form

$$b_1 (EBV_1) + b_2 (EBV_2) + b_3 (EBV_3) + b_4 (EBV_4)$$

for the case where there are just four EBVs available.

Traits and criteria

The traits affecting profitability in commercial herds, and hence which are included in the breeding objective, are shown in Table 1. Feed requirements are assumed related to weight differences. The potential selection criteria are the EBVs available from BREEDPLAN (Schneeberger et al. 1991). The criteria primarily contributing information on each trait are also shown in Table 1.

Where do index weightings (the b's above) come from ?

Index weightings derive from a knowledge of the genetics of the EBVs involved and of the traits of the

Table 1. Traits of the breeding objective and principal selection criteria contributing information on each trait

Selection criteria (BREEDPLAN EBVs)		Traits
Birth, 200-d, 400-d, 600-d weights	→	Sale weight (growth)
200-d (milk)	→	Sale weight (milk)
Eye muscle area, Fat depth	→	Dressing %
Fat depth, Eye muscle area	→	Saleable meat %
Fat depth	→	Fat depth
Days to calving, Scrotal size	→	Cow weaning rate
Scrotal size, Days to calving	→	Bull fertility
Birth weight	→	Cow survival rate
Birth, 200-d, 400-d, 600-d weights	→	Cow weight

objective, including the genetic relationships between these; and from estimates of the relative economic values of the traits to be improved. The formulae utilised are described by Schneeberger et al. 1992.

How are the economic values of the traits determined ?
Breeder-supplied questionnaire responses for a relevant type of commercial herd are utilised to derive these estimates. Partial budgeting is used. Standard questionnaire responses can be used, or these varied (i.e. customised) at the discretion of the breeder. The questionnaire responses determine the relative contributions of traits to the profit objective. This balance is then reflected in the $Index-EBV via the components of the index.

Economic values determined are the estimated change in profit, for a commercial enterprise, from a unit change in a trait, assuming other traits are unchanged. Options are available for computing values assuming either that extra feed is able to be purchased when needed or that the total available feed is fixed. Under the latter assumption, extra requirement is met by reducing stock numbers.

When additional feed can be purchased, the economic value for sale weight is the difference between the value of meat from an extra kg of finished sale animal and the cost of the extra feed needed to produce the extra kg, the estimate then being discounted to present value. The value for sale weight (milk) is similar to that for sale weight (growth) except that the maternal trait is discounted more on account of its later expression in the herd.

The economic value for dressing percentage is the value of the increased weight of meat resulting from a one percent increase in the amount of the live animal that is represented as carcase. The economic value for saleable meat percentage is the value of the increased weight of meat resulting from a one percent increase in the amount of the carcase that is represented as meat.

The value of an extra mm of fat depth, when meat yield is constant, is based on the reduction in incidence of sale animals which fail to meet minimum fat specifications for the targeted market, and from the price penalty incurred for failing to meet this minimum specification.

The economic value for weaning rate derives from the additional profit accruing from an extra one percent of calves, after accounting for additional feed costs and other costs, and from additional effects on profit that arise from changes in the age structure of the herd. The age structure is affected because fewer cows are culled because there are less dry cows.

Bull fertility is valued by the reduction in the average bull cost per cow that occurs when bulls are able to satisfactorally service an additional cow.

The value of improving cow survival rate derives directly from the altered age structure that results from fewer cow deaths. This affects the numbers of cull and cast-for-age cows available for sale, and the number of replacements needed from the young females that would otherwise be normal sale animals. The differing costs of feeding and running the changed herd structure are also taken into account.

Increasing cow weight increases revenue through the sale of heavier cull and cast-for-age cows. There is an additional feed cost, however, in running heavier cows. The economic value of cow weight is assessed as the difference between this additional revenue and additional cost.

Economic values for all traits in B-OBJECT are discounted to account for the differing time delays before expression of the improvement in the herd, and are expressed on a per cow basis.

OTHER FUNDAMENTALS

Before engaging the questionnaire, there are a number of issues to be thought through. For the seedstock breeder, these include what role the improved cattle are to have in industry (e.g. whether to produce straight-bred or crossbred slaughter stock, and if crossbred whether primarily via the sire or dam side), and what kind of slaughter product are genes ultimately going to contribute to ? Also, what kind of production unit and client encompasses these visualised end usages for the improved genes ? Where there are several answers to these questions, each needs to be defined and the further question confronted as to whether there is one alternative which is likely to be most important to seedstock profit over the longer term. These issues decide the type of commercial client and production unit at which the questionnaire should be directed and whether one or several runs of the package are required.

After calculating the relevant economic values and deriving and displaying the breeding objective, the package utilises a matrix of assumed heritabilities and genetic correlations among all of the traits and EBVs to derive the most appropriate index of the available EBVs. The program is told where the EBV file can be found and the index is then calculated for each animal. Results can be sorted or restricted, and displayed or printed. Component EBVs of the index are also displayed.

Numerous other features are also provided to safeguard against inconsistent input, provide for 'what if' capability, and to add to the usefulness of results. Hardware requirements are minimal, and no other associated software is needed. B-OBJECT runs on IBM-compatibles of virtually any capacity.

AVAILABILITY

B-OBJECT will initially be available to industry consultants and advisers trained in its use and interpretation. Breeders utilising the system will do so through one of these special consultants. The package will also be available for research and educational applications. Possible commercialisation arrangements are still being considered. Trialling of the first version to be released is being carried out in association with breeders and industry representatives, and will be completed by the end of 1992. Information on availability after that time can be obtained by contacting the Animal Genetics and Breeding Unit.

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