EFFECTING GENETIC IMPROVEMENT IN BEEF CATTLE AND SHEEP

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INTRODUCTION

The aim of this Workshop is to review and discuss current knowledge of quantitative genetics in terms of its application to the task of bringing about effective genetic improvement in our beef cattle and sheep industries. Many of the important production circumstances of these two industries are similar, as are the basic genetic principles which determine optimum improvement plans. Accordingly it was decided, that as a focus for review and discussion, to structure the session around two invited review papers which transcend both species. The first of these deals with "Data collection, processing and the prediction of breeding values" (Johnson and Garrick, 1990); the second with "Industry breeding structures for effecting and evaluating genetic improvement" (Notter and Hohenboken, 1990). Both papers focus on the opportunities offered by current knowledge and some of its technical limitations, as well as on various other circumstances which affect the application of this knowledge to improvement of productivity in commercial flocks and herds. The dissemination of genetic improvement from seedstock producers to commercial herds and flocks is a major issue which receives particular attention in the second review paper by Notter and Hohenboken (1990), as well as in other contributed papers in the session (e.g. Nicoll, 1990).

Since the invited papers for this session were prepared, a number of additional relevant reports have appeared in the literature. This is inevitable in such a fast-developing field of endeavour. In particular for Australasia, the Australian Association of Animal Breeding and Genetics has discussed a number of developments as part of its conference on the theme of "Technology Transfer" which was held in New Zealand in February of this year. Fortunately, the pre-publication of their proceedings has permitted some early access to this work. Some of the results are reviewed in the papers presented; others are referred to briefly in this introduction to the Workshop.

BREEDING OBJECTIVES

In defining breeding objectives, as Johnson and Garrick (1990) emphasise, economic considerations are to the fore. The increasing involvement of economic principles and even economists in establishing breeding objectives, has resulted in a more complete specification of factors affecting costs as well as returns, and their impact on the different sectors of the industry involved in the production, processing and marketing chain. In particular, approaches have been developed for handling variation in feed costs for grazing ruminants and the need for additional research information clearly identified.

Derivation of appropriate breeding objectives is clearly not a trivial task and can have a large impact on both the choice of breeds and strains and the directions of genetic improvement through selection. The adoption of more formal procedures for this task is encouraging. It is a fast developing area which is becoming an integral part of the consultant's tool-kit as a result of technological advances offered by micro-computers (Atkins and...
Barlow, 1990; Brash et al., 1990) and commercial software packages as well (Mayo, 1990). Both review teams have stressed the importance of providing this sort of customised assistance to breeders, one of its main benefits being to focus attention on the most important factors contributing to economic returns and production costs.

Many of the important costs of animal production are embodied in the concept of adaptability which has rightly been given particular emphasis by Notter and Hohenboken (1990). It is clearly a major source of variation in breeding objectives among different production environments. In general terms, the studies reviewed favour a similar approach for handling adaptability as for complex output traits - a formal breakdown and analysis of component trait contributions to both cost and returns and the inclusion of each in the overall production function representing the breeding objective. It appears that many of the problems of interaction among component traits can be handled adequately in this way.

EVALUATING BREEDING MERIT

Genotype x environment interaction among components of the objective also favour a formal customised approach to the derivation of appropriate decision criteria for the choice among alternative breeds, strains and crosses as well as among individual sires and dams. It is only relatively recently that useful data has become available on which breeders and their advisers may come to grips with this class of potential problems to the design of effective breeding plans (Newman et al., 1990a, 1990b; MacLeod et al., 1990). Notter and Hohenboken (1990) emphasise the important distinction between 'directional' interactions in which definable genotypes and environments are involved and 'random' interactions of the sort involving sires x years. Analysis and consideration of GxE interactions as genetic correlations among different biological traits having the same measurement criterion is proving to be a useful operational procedure for a rational consideration of their impact on genetic improvement plans.

Recent developments to consider simultaneously both within- and among-breed variation in the genetic evaluation process have been discussed in both reviews. Operationally they call for more deliberate genetic ties between national breed evaluation programmes and breed improvement schemes operating at the sire level as reviewed by Notter and Hohenboken (1990). Ties of this sort can provide the commercial proof of genetic improvement and are likely to be an important stimulus to a more widespread adoption of performance recording through our sire-breeding industries (Peart, 1990).

The reviews and contributed papers of this Workshop have identified several circumstances favouring an indirect assessment of breeding merit using correlated traits. These include traits associated with body composition, and disease resistance which are expensive or difficult to measure directly, and those arising from the sex-limited expression of the reproductive complex. It is likely that many more will emerge as new DNA-technologies are developed and as new electronic measurement techniques become more cost-effective (Jordan and Schaare, 1990). In this light, breeders must heed the warnings implicit in many experimental attempts to rely exclusively on indirect marker traits as sole selection criteria (Davis and McGuirk, 1987; Crook and James, 1990), as emphasised by Johnson and Garrick (1990) in their review below. BLUP procedures which readily permit the inclusion of data on relatives for the trait of direct relevance to the breeding objective offer some comfort to this problem.
Indirect selection, however, can have the important added advantage of allowing selection at an earlier age with consequent reduction in the generation interval and in the costs of rearing large numbers of replacement stock merely to allow breeding value assessments to be made later in life. The latter cost savings can be an important incentive and have encouraged the development of multi-stage selection approaches to genetic improvement plans (Atkins et al., 1990). Microcomputer software packages offer considerable potential to formalise the cost-benefits of such multi-stage animal evaluations for individual breeder circumstances (Atkins and Barlow, 1990). They also offer much promise to the effective adoption of sound evaluation procedures by providing for a more user-friendly reporting of breeding value rankings to seedstock producers and their clients (Apperley and Blakey, 1990) and through software which allows breeders and their advisers to critically examine the consequences of alternative breeding plans extending across several flocks or herds (Kinghorn, 1988).

INDUSTRY STRUCTURES

Several papers discussed at the Workshop have highlighted the major impact which AI can and does have on the integration of breeding programmes across different flocks or herds. These and other reproductive technologies offer much scope for more accurate selection decisions, improved dissemination of genetic merit and the establishment of assortative matings within the overall breeding population. Shepherd et al. (1990) have reported some interesting preliminary results of recent studies on these questions and include a consideration of the effects of inbreeding arising from variations in effective population size in open versus closed nucleus schemes with two- and three-tier structures. Cost considerations remain an important practical issue. Costs must be examined in terms of the variability of the response to reproductive enhancements as well as in terms of the average level of the response and for responses obtained under truly commercial conditions as well. These questions appear to merit much more careful study before their true practical cost benefits can be gauged. As Notter and Hohenboken (1990) emphasise, long-term risk considerations are one additional issue of any widespread commercial advocacy.

REFERENCES


