GENOMICS CONTRACT SESSION

Current status and future of genomic selection

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INTRODUCTION

DNA marker test usage is expanding rapidly in the New Zealand livestock industry. Uptake is already reaching in excess of 30% of animals in the sire breeding tier for some industries. However, what is confusing to many commercial farmers and advisors is the diversity of claims and uses of these tests and the jargon that surrounds the topic. The aims of the associated Landcorp Speaker presentation and this contract, are to clarify just what DNA markers can do, what work is currently being undertaken, what tests are currently available, and what implications these have for farming systems in New Zealand over the next decade.

DNA markers can only provide 4 pieces of information: animal identity, parentage, prediction of an animal's breeding worth and its individual performance. The ideal situation is where all these pieces of information are derived from the results of a single test. Currently, most tests only address one, maybe several, of these requirements, but typically not in a comprehensive manner. However, like the computer industry, the test's power is increasing exponentially while costs decline. This has recently allowed what is called genome wide selection (GWS) to be considered as a practical approach to improving genetic gain. Its introduction will be a major transformative change to these industries and its implications are certainly worth understanding by scientists and practitioners working in other parts of the animal production system.

GWS describes the process where enough markers are used to allow segments of DNA to be traced over many generations, even in the absence of knowledge about pedigrees. These little signposts in turn allow us to determine if that region also has an association with traits of interest. In addition, but unlike traditional breeding schemes, it can also easily identify if certain variants located in different parts of the genome actually interact with each other. Typically, these combinations predict an individual's current or future performance, rather than their breeding worth, but complicate the prediction of the latter. Its introduction may be able to double the existing rate of genetic gain. Technically, its introduction will merge into existing genetic evaluation and DNA testing regimes. However, its use could markedly alter each industry's breeding structure as it adapts to take advantage of the benefits.

The first paper by Hayes & Goddard (2007) describes what GWS is and the potential benefits it offers to the dairy industry, and especially the changes that are likely to occur in the industry, which has used the existing milk recording and progeny test model for the last 50 years. It is particularly relevant because many dairy breeding companies have announced or are planning to commence GWS. The second paper by McEwan (2007) describes the creation of the genomic resources needed for GWS and other DNA tests, and the status of each New Zealand livestock species. The third paper by Morris *et al*. (2007) reviews the history, results and current animal and trait measurements in New Zealand resources used for DNA studies. These will typically act as the basis on which GWS technology will be first evaluated. The paper by Dodds *et al*. (2007) takes a close look at each New Zealand industry and speculates on when and how GWS will be introduced, where the opportunities exist and what changes will be required. The focus then shifts to what DNA technology is currently available to New Zealand farmers and breeders. The paper by Campbell & McLaren (2007) reviews how the existing DNA marker tests are validated before industry release. This is followed by Crawford *et al*. (2007), who review what DNA tests are currently available, how widely they are used in industry, and how GWS testing will modify their use.