DEERSelect – review of the first decade

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Abstract

DEERSelect, the New Zealand deer industry performance recording system, has been operating since 2005 in red deer. Over that period, the role and functionality of DEERSelect has grown, such that it is now central to all genetic information delivery to the industry. Initially velvet and growth trait modules were included, with meat and reproduction trait modules added later. Economic indexes were also developed, but have not been widely utilised. Evaluations were added for wapiti, to provide for all breed types. Current desires are for wapiti and red deer to be combined in a single evaluation. Good genetic gains have been made, primarily in growth traits. Impetus provided by the Deer Progeny Test (DPT), and increased breeder education has improved understanding of best practice recording, leading to better data quality and herd connectedness. While DEERSelect is recognised by industry leaders as being critical for genetic advancement, it still has limited stag-buyer adoption. Improved adoption will require a large extension effort so commercial producers can interpret the impacts of breeding values in terms of changes in farm system performance and profitability. The future is promising, with new traits, improvements on existing ones and breeders now valuing objective measures of genetic merit.

Keywords: red deer; wapiti; genetic selection; breeding values

Introduction

Deer have been farmed in NZ for over 40 years and, uniquely for livestock foundation stock, were originally from wild captured sources (Archer 2003), with genetic improvement primarily from imported strains sourced from game parks or estates from the United Kingdom or Europe (red deer), or North American wild stock (wapiti). The early breeding focus was mainly on antler improvement (Pearse & Amer 2001), which made rapid genetic progress (Archer 2003) as antler traits are generally highly heritable (Van den Berg & Garrick 1997). Much of this history was well summarised by Garrick et al. (2000), Pearse & Amer (2001) and Archer (2003).

Changes in industry income from 50:50 venison:velvet antler, to around 85:15 over the past 15 years, in favour of venison, means that industry breeding objective focus has shifted to moderately heritable growth and meat-yield traits. Selection for such traits required objective genetic selection tools and in 2005 DEERSelect was implemented (Archer et al. 2005). DEERSelect operates on the Sheep Improvement Limited (SIL) platform (Newman et al. 2000) under a partnership agreement with Beef and Lamb New Zealand using deer specific trait modules (Archer et al. 2005). The DEERSelect vision is “to provide genetic tools to assist deer breeders in the improvement of traits which are economically important to deer production” DEERSelect has now been operating for ten years, during which time there have been many changes in the New Zealand deer industry including; farming systems, farmer knowledge of genetic improvement, and technologies for phenotypic recording.

Industry fluctuations

The deer industry has undergone a marked contraction during the last ten years (Fig. 1), with farmed deer numbers almost halving since 1995 (Statistics NZ 2015). This has been attributed to a number of factors including price volatility, land-use change, and market-force flow-on effects of the historic Asian financial crisis and BSE scare in Europe, and more recently the global financial crisis. Such market volatility impacts sire-stag-purchasing decisions and prices which can fluctuate between years for sires of the three products; venison, velvet (soft) antler, and trophy antler (hunted) stags depending on the market returns (Archer et al. 2005). Despite this contraction in the national herd, the number of (non-research) red deer herds on DEERSelect has remained fairly static at around 20 over the past decade, while the mean number of recorded progeny per herd has increased from <300 to around 400 (Table 1).

As a result there is currently a greater percentage of the national deer herd being objectively measured and recorded on DEERSelect and available to be purchased for breeding sires than in 2005 (Fig 1). At a 1:30 sire-to-hind mating ratio, with a 25% sire-replacement rate in commercial herds (Garrick et al. 2000), and 25% of DEERSelect recorded males being offered for sale as sires, this could satisfy approximately 30% of the replacement sire market, compared with less than 10% in 2005.

Enabling technologies

Over the past decade, there has been increased adoption of some key enabling technologies as they have become more affordable, better understood, or more accessible. These include trans-cervical artificial insemination (AI) (Rhodes et al. 2003), which has increased uptake of AI over traditional laparoscopic methods. Semen prices have dropped dramatically from $250-$750 per semen straw in the early 2000s (Pearse & Amer 2001) to currently around $70-100 per straw today.
DNA pedigree matching (Ward et al. 2001), for entire cohorts as opposed to selected individuals, has now been widely adopted, increasing from around 40% of sire breeding herds (Anderson et al. 2007) to greater than 80% at present (KM McEwan pers.comm.). This has reduced the reliance on pedigrees obtained through single-sire mating and calving, manual matching at birth, or time-consuming observation post-birth (Garrick et al. 2000). Ultrasound scanning estimation of conception date (White et al. 1989) has allowed a proxy for birth date in lieu of these observational birth-recording methods. Recording of date of birth date directly or via ultrasound is to become mandatory on DEERSelect from 2017.

The introduction of compulsory electronic identification of farmed deer and better electronic recording systems have increased ease of data collection, saving time and reducing human recording errors.

Corporate stud-stock producers with breeding programmes designed by geneticists within Landcorp Farming Limited, now selling genetics as Focus Genetics (Nicoll 2014), and Deer Improvement (Gudex et al. 2013), focussed their efforts on live weight and meat yield traits. These breeding companies, using scientific breeding principles, have made rapid genetic progress. Genetic gain achieved by Deer Improvement for the replacement early kill index (R-EK) was greater than twice the industry average at $1.60 per annum (Gudex et al. 2013).

The DPT focussed breeders on improved recording and connectedness (Ward et al. 2014), and also demonstrated to breeders the performance of their sires in commercial operations. The appointment of a DEERSelect Manager in 2013 by Deer Industry New Zealand (DINZ) has greatly increased the extension and education component of DEERSelect. This appointment was made in recognition of the importance of DEERSelect in underpinning the whole industry genetic improvement.

This range of initiatives has combined to increase DEERSelect uptake. Competitive pressure from corporate stud-stock producers has probably reduced semen price and encouraged increased quantitative trait recording on DEERSelect. Cheaper semen and simpler AI has served to more widely spread better genetics and improve the national stud stock herd. Simpler and more accurate pedigree and phenotype collection, the focus provided by the DPT including better herd connectedness, along with increased extension and education of breeders have all contributed to increased recording on DEERSelect, improved the accuracy of its outputs and resulted in more-rapid genetic progress.

**Challenges**

As the number of herds recording on DEERSelect is small, recent additions of new herds to the across-herd evaluations has reduced the average overall breeding values of all herds. This is because new animals (predominantly dams) entering the DEERSelect evaluation are initially assumed to be of equal genetic merit as older foundation herds.
animals, irrespective of birth year. Estimates of merit are updated over time as sufficient information on individuals or their progeny is collected. ‘Genetic groups’ has been investigated to overcome this problem, but has not yet been implemented. ‘Genetic grouping’ works by grouping similar (i.e., by herd, year and/or pedigree) animals together and then assigning estimated breeding values (EBVs) based on similar animals to foundation animals of the new herds.

In 2010, a software issue was identified which related to the construction of mob codes, such that when a mob code exceeded 16 digits a truncated mob code was created. For some herds this caused erroneous breeding values, depending on their recording practices. Overall, the change in rankings was minimal but the drop of around 10% (2 kg for trait leaders) in 12-month live weight estimated breeding value (W12eBV) unsettled breeders and purchasers alike. While this error was quickly identified and corrected, it had a notable effect on end-user confidence in DEERSelect which may still persist to today, hence improving confidence in DEERSelect was one of the drivers for industry to improve herd connectedness via the DPT.

Currently the two breeds, red deer and wapiti (and their crossbreds), are analysed separately. This was due to insufficient genetic links were and the fact that the two breeds are quite different in body mass. The DPT has now recorded red x red, and red x wapiti progeny together as a single cohort and estimated combined genetic parameters for these breeds. This analysis used a genomic breed based on the proportion of the three major subspecies, English red deer, Eastern European red deer and North American Wapiti (Cervus elaphus scoticus, hippelaphus and canadensis) respectively (Archer et al. 2007). Breeding and breed effects were estimated for each of the three breeds with breed effects then added back to the breeding value according to breed proportions, to produce a final breed-corrected estimated breeding value.

Despite the introduction of maternal trait EBVs and indexes; conception date (Archer et al. 2013) and replacement early kill (Archer & Amer 2009) respectively, there are highly variable levels of recording of date-of-conception, and mature-hind live weight. Without these being well recorded and reported it is difficult to get stag purchasers to appreciate DEERSelect for much other than growth traits.

Multiple-trait economic selection indexes were introduced in 2009 (Archer & Amer 2009). These have been poorly adopted in the industry, and W12eBV is still the favoured measure of genetic merit. Several breeders cite their failure to adopt the index values is due to the economic values being too low, and there are also negative perceptions of an autumn-growth penalty. Breeders initiated research using an optimised farm-system model (INFORM, Rendel et al. 2013) to recalculate economic index values; in short this corroborated the dollar values of the existing index. This alternative method has not been adopted by industry at this point: with breeders still concerned about the economic values produced and the complexity of calculation. In the future, focus may be best placed on communicating the utility of indexes to selection programs.

The small size of the deer industry and DEERSelect database can amplify issues that would hardly be noticed on much larger databases. At the same time the small size allows problems to be more easily isolated and identifies, also provides the opportunity to investigate and adopt new analysis practices that larger industries (e.g., sheep) would find more difficult to do. But problems such as breeding values reducing over time, in an industry that is still learning how to utilise them, can stifle adoption. This can only be overcome with high-quality extension and education efforts. Part of this should include more, and better recording of maternal traits, as well as communication of the utility and value of selection indexes.

**Current situation of stud-stock sales**

EBVs and/or economic index values in general appear to be presented by breeders as secondary in importance to phenotypic measures for the selection/purchase of replacement sire stags (usually at two and three years of age) at stud-stock catalogues. The W12eBV is often the only EBV quoted in sale catalogues, and is presented alongside actual live weights and velvet weights. This presentation of estimated genetic merit alongside unqualified phenotypic measures often confuses prospective purchasers. Some breeders also present outdated (not the most current) herd sire EBVs, due to the problem of EBVs reducing overtime, such EBVs of historic sires may be lower than they used to be.

Demand for both velvet and trophy antlers is still high and, as such, the sires bred for these purposes tend to command a higher price than venison sires, leading many venison sire breeders to feel they are not sufficiently financially rewarded for their inputs. One challenge from this is that antler breeders measure velvet traits as part of the production process with stags annually cutting heads of velvet antler worth $100-$1500. Other trait recording is often viewed as a cost to the breeder including time spent weighing, ultrasound conception date and eye muscle area costing $2-$10 per head, and CT scanning >$400 per animal, although much of it does confer management advantages.

DEERSelect needs more stud-stock purchaser (commercial farmer) demand for informative genetic merit, and they need to have an understanding on how it will impact their farming system. This requires all producers to have well-defined breeding objectives (Garrick et al. 2000). There is also a need for EBVs for wapiti and red deer to be on the same scale (i.e., be directly comparable), so all production systems are using the same information.

There are still a few technical issues to resolve. We need to get users to understand why EBV fluctuations can occur and how they can reduce them by recording fully and correctly. Better recording of a wider range of traits should also increase the spread of index values and aid index adoption.
Impact

Both red deer and wapiti herds actively recording on DEERSelect have made rapid genetic gain in the past 10 years (Fig 2, Table 2). Liveweight traits for red deer and wapiti overall have been increasing at more than three times the rate of the previous decade (Table 2). Over the same time, genetic progress for two-year velvet has slowed to around 70% that of the 1995-2004 period (Table 2). Red deer yearling liveweight gains translate to an increase from a 51 to 55 kg carcass, based on a 91.1 kg average DEERSelect yearling weight in 2005. Yearling weights have increased at around 700 g annually and terminal indexes at >$1.00. Focussed commercial producers regularly replacing genetics from top-performing breeders should be able to achieve genetic gains at a rate equal to their breeder. Thompson et al. (2015), showed using linear program modelling, based on actual EBV genetic gain data from DEERSelect, that venison-production farming systems in New Zealand would become more profitable due to those genetic gains in the modelled traits.

Future

The DPT has provided new genetic parameters for growth, meat yield and quality traits across the two breed types, as well as temperament (Schütz et al. 2016), parasite antibody response and skin quality (Ward et al. 2014, 2015). Many of these traits will be incorporated into DEERSelect over the next 12 months. Genomic breed tools and genetic groups are both close to implementation, as is combining red and wapiti in a single analysis. The genomic breed estimation could change utilise different genotyping technology in the near future (Rowe et al. 2015). Other research is ongoing, investigating possibilities for using genotyping, to increase EBV accuracy, or produce genomic breeding values in deer (Rowe et al. 2015) in the future.

Extension work by the DEERSelect Manager is ongoing and a genetic communication strategy is being developed by DINZ, to improve industry understanding of genetic breeding values and DEERSelect. These extension efforts will focus on commercial producers, as the breeders now have a greatly improved understanding of measures of genetic merit and how to best record them.

Conclusion

Garrick et al. (1992) listed six major components for national genetic improvement: committed buyers, motivated breeders, database, breed value prediction, animal breeding research and extension. DEERSelect has an excellent resource in the SIL database, providing estimated breeding values. The core of breeders on DEERSelect are committed, motived and improving the quality of their recording. Genetics research is the major component of the DEEResearch portfolio, all of which is integrated with DEERSelect. Buyer commitment and understanding are currently the weak link and this can only be improved with an increased focus on extension. When commercial producers are better able to comprehend and quantify the benefit of the genetic gains made by breeders recording on DEERSelect, the New Zealand deer industry will better capture the benefits of its investment over the past ten years of DEERSelect.

Table 2 Change in rate of genetic progress from ten years before and ten years after DEERSelect for estimated breeding values of recorded herds of red and wapiti breeds for a selection of traits and indexes in New Zealand.

<table>
<thead>
<tr>
<th>Breed</th>
<th>Period (Years)</th>
<th>WWT</th>
<th>AWT</th>
<th>W12</th>
<th>CW</th>
<th>MWT</th>
<th>CD</th>
<th>VW2</th>
<th>MVW</th>
<th>R-EK</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>1995-2004</td>
<td>1.53</td>
<td>1.80</td>
<td>1.76</td>
<td>1.02</td>
<td>1.47</td>
<td>-0.20</td>
<td>0.296</td>
<td>0.463</td>
<td>$1.67</td>
<td>$3.44</td>
</tr>
<tr>
<td>Red</td>
<td>2005-2014</td>
<td>4.59</td>
<td>6.10</td>
<td>7.61</td>
<td>3.86</td>
<td>5.22</td>
<td>-0.98</td>
<td>0.209</td>
<td>0.299</td>
<td>$6.26</td>
<td>$12.49</td>
</tr>
<tr>
<td>Red</td>
<td>Increase since DEERSelect</td>
<td>300%</td>
<td>339%</td>
<td>433%</td>
<td>378%</td>
<td>355%</td>
<td>483%</td>
<td>71%</td>
<td>64%</td>
<td>376%</td>
<td>363%</td>
</tr>
<tr>
<td>Wapiti</td>
<td>1995-2004</td>
<td>1.55</td>
<td>1.72</td>
<td>1.82</td>
<td>0.98</td>
<td>3.17</td>
<td>3.17</td>
<td>3.17</td>
<td>3.17</td>
<td>$3.43</td>
<td></td>
</tr>
<tr>
<td>Wapiti</td>
<td>2005-2014</td>
<td>3.30</td>
<td>4.77</td>
<td>6.41</td>
<td>3.16</td>
<td>8.61</td>
<td>8.61</td>
<td>8.61</td>
<td>8.61</td>
<td>$10.32</td>
<td></td>
</tr>
<tr>
<td>Wapiti</td>
<td>Increase since DEERSelect</td>
<td>212%</td>
<td>276%</td>
<td>353%</td>
<td>321%</td>
<td>271%</td>
<td>271%</td>
<td>271%</td>
<td>271%</td>
<td>301%</td>
<td></td>
</tr>
</tbody>
</table>

WWT = weaning live weight, AWT = autumn live weight, W12 = 12-month live weight, CW = carcass weight, MWT = hind mature live weight (all kg), CD = conception date (days), VW2 = 2-year-old velvet weight, MVW = mature velvet weight (both kg), R-EK = replacement females retained, males killed early for venison, and Terminal = all progeny killed early for venison.
References


Thompson BR, Stevens DR, Bywater AC, Rendel JM, Cox NR 2015. Impacts of animal genetic gain on the profitability of three different grassland farming systems producing red meat. Agricultural Systems 141: 36-47


