AT WHAT PRICE IS DNA PEDIGREEING COST EFFECTIVE FOR MERINO BREEDERS?

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SUMMARY

DNA pedigreeing is a simple and accurate way for Merino ram breeders to record pedigrees. This technology is currently priced at around $25 per sheep and whilst work is underway to reduce the cost of the test we need to know what ram breeders would pay for this technology before a large scale commercial DNA pedigreeing service could be set up. A spreadsheet was developed to conduct benefit-cost analyses of DNA pedigreeing systems for Merino breeders. Currently, only breeders receiving very high prices for their rams would make a net profit from using DNA pedigreeing. The price of DNA pedigreeing will have to fall to around $10-$15 per sheep before the technology will be an economically viable option for many breeders and so it will not be before this price drop that DNA pedigreeing is widely adopted by Merino breeders.
Keywords: DNA pedigreeing, Merino, selection.

INTRODUCTION

DNA pedigreeing will provide Merino ram breeders with accurate pedigree information that can be used to estimate breeding values (EBV's) with greater accuracy than those estimated using individual phenotypic information only. These EBV's can be linked over time and so breeders are able to benchmark genetic progress. Benefits from DNA pedigreeing also accrue from premiums paid for rams with a DNA pedigree. DNA pedigreeing is expensive ($25 per sheep) and CSIRO Division of Animal Production is working on reducing the cost of DNA pedigreeing by simplifying the DNA collection and processing methods. The technology involved in this work is developing at a rapid rate and we can also expect decreases in the purchase and running costs of equipment. We need to know what breeders should pay for the test and still make a profit before a commercial DNA pedigreeing service could be set up. So, our aims were to find prices of the test at which Merino breeders would break even, and to find the net present value of benefits to the breeders at different prices of the DNA fingerprinting test, given that breeders differ in the emphasis placed on objective measurements and in the prices they received for rams.

MATERIALS AND METHODS

SELIND (Cunningham 1970) was used to predict the increase in genetic gain achievable when using pedigree information from sires, dams and paternal half-sibs to make selection decisions compared to selecting animals based on individual phenotypic information only. Heritabilities and the genetic and phenotypic correlations used were those used in the Merino industry's genetic

improvement program, RAMPOWER (K.D. Atkins pers.comm.). A breeding objective of increasing clean fleece weight and decreasing average fibre diameter was assumed. The selection criteria used in the computer simulations were hogget greasy fleece weight and hogget average fibre diameter.

Spreadsheet. A spreadsheet was developed which modeled a benefit cost analysis of DNA fingerprinting over a ten year period. The benefit is the increase in genetic gain from using full pedigree information to make selection decisions compared to using only individual phenotypic information. The cost included is the cost of DNA pedigreeing. Other fixed costs such as shearing costs were not included in the model as they do not change regardless of whether the animals have a DNA pedigree or not.

Assumptions. The following assumptions were made in the model:

- A discount rate of 4%.
- There were 1100 breeding ewes in the flock.
- All breeding ewes and rams had a DNA pedigree. This is a once only cost as the pedigree is kept on record for following years.
- All ram lambs were and no ewe lambs were DNA pedigreed. This meant that no extra genetic gain was made from selecting hogget ewes as they did not have pedigree information available. All ewe hoggets not selected for the breeding flock were culled.
- 40% of ram lambs were offered for sale at 18 months of age. Rams that were neither sold at 18 months or kept as stud rams were culled.
- The generation interval for rams was 3 years and for ewes it was 5 years.
- The selection intensity of rams was 2.295 and of ewes was 0.362.
- The initial average fibre diameter of the ewes was 21μ, of the rams was 22μ and of the hoggets was 20μ.
- The initial greasy fleece weight of the ewes was 5.5kg, rams 6.5kg and hoggets 5kg.
- The initial price for wool was 800 c/kg clean for 20μ wool
- Micron premium for wool was 10%.
- Wool yield was 70% and wool levies and selling costs were 8.5% of the clean wool price.
- There were four different prices that breeders could receive for their rams. These were $500, $1000, $1500 and $2500.
- A premium was paid for rams that had a DNA pedigree. This was 5% for rams that sold for $500 or $1000 and 10% for rams sold for $1500 or $2500.
- DNA tests were costed at $10, $15, $20 and $25 to compare the net present values of benefits at these different prices.

Selection emphasis. This is the efficiency with which breeders can select the best animals from which to breed. This is between 30-40% when sheep are selected only by visual assessment and is between 70-80% when breeders base their selection decisions on an index and visual assessment (Semple *et al.* 1995). Different scenarios were modeled in which the selection emphasis was varied from 40-100%.

RESULTS

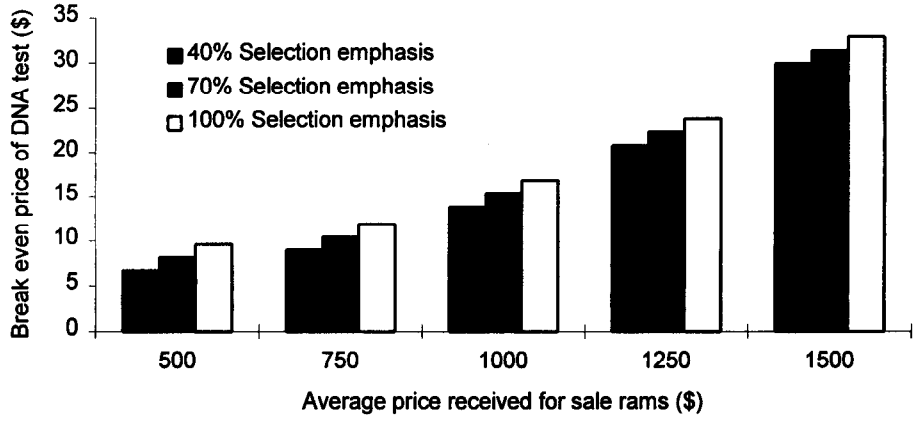

Figure 1. The effect of selection emphasis and price received for rams on the break even price of DNA pedigreeing.

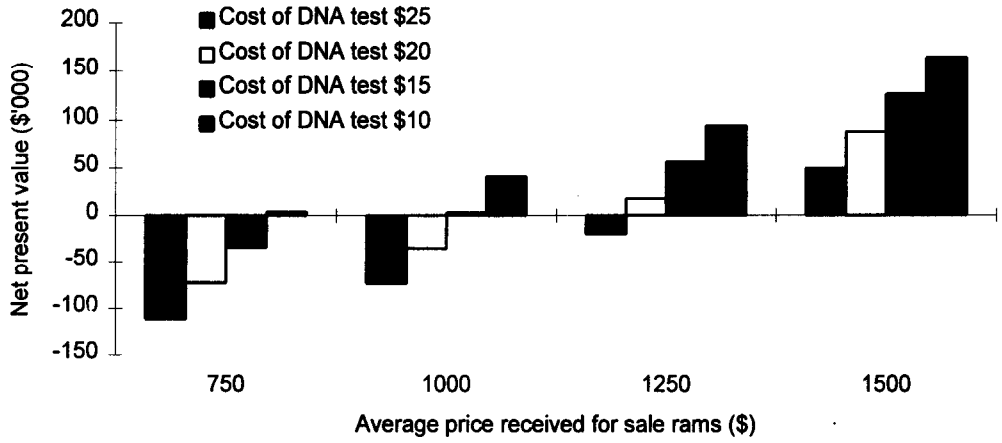

Figure 2. The effect of DNA test price and ram sale prices on net present value of benefits from the DNA pedigreeing of animals assuming 70% selection emphasis.

As the average price received for rams increases the break even point of DNA pedigreeing also increases (Figure 1). For example, at 70% selection emphasis breeders receiving an average of $1000 for their rams and who DNA pedigree their animals would break even at a DNA pedigreeing cost of $15.36 and breeders receiving an average of $750 at the same selection emphasis would break even at $10.45. If the DNA test is lower than this point then the breeder

will be making a profit. Figure 1 also shows that as selection emphasis increases so does the break even cost of DNA pedigreeing.

As the cost of DNA pedigreeing goes down the net present value (NPV) of benefits increases (Figure 2). When the DNA test costs $10 breeders make a profit over the whole range of ram sale prices in this study. At $15 breeders averaging between $1000 and $1500 make a profit but those averaging $750 make a net loss. At $20 only those breeders averaging $1250 or more will make a profit. At $25 only breeders averaging $1500 will make a net profit over the ten year period.

DISCUSSION

When the cost of DNA pedigreeing falls below $15 all breeders who average $1000 or more for their rams will find it profitable to DNA pedigree their animals. With DNA pedigreeing currently costing around $25 per sheep it will only be profitable for breeders whose rams average more than $1500 to DNA pedigree their animals. Breeders receiving less than $750 for their rams will need to wait until the cost of DNA pedigreeing is around $10 before it is an economically viable option. When the price of DNA pedigreeing is between $10 and $15 it will be an economically viable option for many Australian Merino breeders.

For breeders receiving $1500 for their rams the NPV of benefits for the ten year period would be greater than $100 000 when the DNA test is $15 and over $150 000 when the test is $10. For the whole range of ram prices breeders will be making a net profit when the DNA test is $10 (Figure 2) suggesting that wide adoption of this technology is likely at this price. So, as DNA pedigreeing becomes cheaper over the next few years we could see huge changes in pedigree recording systems in the Merino industry and greater genetic gains made by breeders.

The spreadsheet assumed a premium on ram sales of 5% or 10%. At very high prices (greater than $10 000) this premium could even be higher than this, amounting to greater profits to the breeder and a lower break even price of DNA pedigreeing. The spreadsheet also assumes current depressed wool prices but as the market becomes stronger the increase in genetic gain from using full pedigree information will be worth more to the breeders and ram prices should also increase and so their NPV of benefits will increase.

DNA pedigreeing will also facilitate the use of marker assisted selection for production traits in future years. This will further increase genetic gain and enhance the uptake of this technology by breeders.

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