THE EFFECTS OF HIGH PROTEIN JERSEY SIRES FROM NEW ZEALAND AND NORTH AMERICA ON DAIRY FARM PROFITABILITY AND IMPLICATIONS FOR THE NEW ZEALAND DAIRY INDUSTRY

A thesis presented in partial fulfilment of the requirements for the degree of Master of Agricultural Science at Massey University

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ABSTRACT

Due to the increasing value of milk protein to New Zealand dairy farmers, a computer model was developed to evaluate the changes to farm production and profitability which could be expected from using dairy sires with high genetic merit for protein yield. The model simulates the influence of differing sire BI and daughter liveweight on average yields of fat, protein and milk, as well as liveweight per cow in a base herd. The assumed productive and genetic characteristics of the base herd are taken from 1992 average figures for the New Zealand population of Jersey cattle (Dairy Statistics, 1992), with the main objective of the model being to calculate the marginal profitability (ie. 'improved' herd - base herd) generated per cow and per hectare by an individual sire after his first generation of daughters have completed one lactation in the base herd. This assumes an annual herd replacement rate of 25%. The prices of milk and meat, as well as the costs of production are 1992 season values. Only those costs directly affected by genetic improvement are included in the calculations. Fourteen proven Jersey sires were put forward by the New Zealand Jersey Cattle Breeders Association (NZJCBA) to be evaluated using the model. Included were 10 New Zealand (NZL) Jersey sires and four North American (USA) Jersey sires with New Zealand proofs.

Positive relationships were established between sire protein BI and his average effect on yields of fat, protein and milk per cow in the base herd. By the time their daughters had completed their first lactation, the four USA sires had, on average, generated greater changes in per cow yields of fat (+3.3kg vs +2.5kg), protein (+2.6kg vs +1.3kg) and milk (+100kg vs +29kg) than their New Zealand counterparts. This resulted in the NZL sires generally boosting milk solids concentration per cow in the herd while the greater proportional milk yields of the daughters of the USA sires decreased milk solids concentration per cow.

No relationship was observed between the effect of sire BI's for fat, protein or milk on the average liveweight of their daughters. Changes generated to average liveweight per cow in the base herd were only small, ranging between -2.2 and +2.5kg. On average, the four USA sires tended to decrease cow liveweight while the NZL sires tended to increase it (-0.2kg vs +0.3kg).

Achievable stocking rate decreased as sire protein BI increased. The influence of a sires high genetic merit daughters on greater average production per cow in the herd caused associated increases in annual feed requirement per cow. These ranged between -4 kg and +52kgDM/cow/year. The effects of individual sires on achievable stocking rate ranged between -0 and -0.04 cows/hectare by the time daughters had completed one lactation. The greater influence of the USA sires on average milk and solids yields per cow was evident by their larger depressing effect on stocking rate compared with the NZL sires (-0.03 cows/ha vs -0.02 cows/ha).

The positive relationship observed between sire protein BI and marginal profit generated per cow in the herd was mainly due to their associated increases in yield of milk solids rather than changes to average cow liveweight. For individual sires, marginal profit per cow ranged between +$5 and +$24, with the 4 USA and 10 NZL sires averaging +$21 and +$15 per cow respectively. Using theoretical values for sire BI's (fat, protein, milk) and average daughter liveweights in the model, it was found that for two sires differing by 5 protein BI units to achieve equal profit per cow, the lower BI sire must have either +7 fat BI units, -32 milk BI units or daughters weighing an average of 20kg more.

The marginal profit per hectare generated by individual sires increased with greater sire protein BI. Estimates ranged between +$14 and +$33 per hectare, with the 4 USA sires and 10 NZL sires averaging +$28 and +$22 per hectare respectively. It was estimated that for two sires differing by 5 protein BI units to achieve equal profit per hectare, the lower sire must have either +10 fat BI units, -14 milk BI units or daughters weighing an average of 10kg less. The economic influence of a 1kg increase in the average liveweight of cows in the herd was estimated as a reduction of $0.49 in marginal profit per hectare.

A sensitivity analysis of the results generated by the model was carried out by varying the prices of milk components and carcasses. Assumed price changes ranged between ± 25%. Changes to protein prices had the greatest influence on both the marginal profit per hectare and the ranking of the 14 selected Jersey sires. The average marginal profit per hectare generated by the 4 USA sires remained ahead of the NZL sires in all cases but the difference was reduced by both a decrease in protein price relative to other milk components and/or an increase in the milk volume charge. Changing carcass prices had very little effect on either marginal profit per hectare or ranking of the sires.

The second part of the study involved assessing the potential impact of using both New Zealand and North American genetics on the supply of milk and milk solids to the New Zealand processing industry. Based on past rates of genetic improvement in both countries, two scenarios were assumed ie. using only New Zealand sires or using only USA sires in the New Zealand dairy industry. These cases were chosen to represent the possible extremes between which actual milk composition could vary in the future. Estimated genetic gains in the two countries indicate that USA Jerseys have in the past achieved greater annual rates of improvement in fat (1.4% vs 1.3%) and milk (1.6% vs 1.2%) yields per cow while protein yield has improved at a lesser rate (1.1% vs 1.4%). Under the assumption that only USA sires (ie. USA rates of genetic gain) were used in the New Zealand dairy industry, the predicted yield increases for the average New Zealand Jersey cow after 30 years would be greater for fat (+64kg vs +61kg) and milk (+1260kg vs +990) yield per cow and less for protein yield (+35kg vs +45kg) than if only New Zealand sires were used. A significant result of the changes to milk composition generated by the USA sires are the decreases in milk solids concentration and protein:fat ratio per cow. Under current New Zealand prices for milk components and methods of milk payment the effect of decreasing milk concentration will probably mean that in future years using the 'average' New Zealand bred Jersey sire over a given herd should provide an increasing economic advantage over what could have been achieved by using an 'average' USA sire.

Using the predicted increases in yields per cow, trends in the supply of milk components to the processing industry from the New Zealand Jersey population were established. This assumed that the increases in production and hence annual feed requirement per cow would require a practical reduction in achievable stocking rate of 15% over the next 30 years. Using only USA sires boosted the annual supply of fat (+19.5 vs +18.1 million kg) and milk (+416 vs +273 million kg) to the industry and lowered the supply of protein (+8.2 vs +13.7 million kg) relative to the case when using only New Zealand sires. The implications of such increases in volumes of milk available for processing each year would mean a required increase in total industry processing capacity of +9 million kg (+0.5%) and +14 million kg (+0.8%) per year under New Zealand and USA rates of genetic gain respectively. The long term marginal cost to the industry of using USA genetics is therefore likely to be a larger investment by dairy companies in additional processing capacity, over and above that required from using solely New Zealand sires. This was supported by the findings of a case study involving a major New Zealand dairy cooperative in which the predicted effects of using only USA sires generated supply increases of fat and milk which exceeded past rates of annual company improvement. However future market developments which see milk components such as lactose incorporated into the milk payout and/or a reduction in the value of protein relative to fat could see a favourable swing towards the greater milk yields of USA Jerseys. The predicted long term negative influence of USA Jersey genetics under past rates of genetic gain illustrates the importance of maintaining selection objectives in line with current and future New Zealand systems of payment for milk.

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