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**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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1992

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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 $\pm 25\%$. 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.

ACKNOWLEDGEMENTS

I would like to extend my thanks to my supervisors, Professor Colin Holmes and Doctor Dorian Garrick, without who this study would have been made far more complex (and longer!). Your intellectual input and critical discussion was greatly appreciated.

Thankyou also to the New Zealand Jersey Cattle Breeders Association, your extreme patience and enthusiastic dedication to your breed were inspiring to say the least. I gratefully acknowledge your financial support to the project without which my continuing studies would have been difficult.

Lastly, thankyou to the friendly staff and post-graduate students of the Animal Science department who made the year an enjoyable one.

TABLE OF CONTENTS

TITLE PAGE	i
ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES AND FIGURES	v
1. INTRODUCTION	1
2. DAIRYFARM PROFITABILITY	4
3. FACTORS AFFECTING MILK PRODUCTION PER COW	6
3.1 Energy Supply	6
3.2 Body Condition	9
3.3 Genetic Merit	11
3.4 Body Size	16
3.5 Age	22
4. FACTORS AFFECTING MILK PRODUCTION PER HECTARE	24
4.1 Stocking Rate	24
4.2 Genetic Merit	24
4.3 Body Size	26
5. THE NEW ZEALAND DAIRY INDUSTRY	28
5.1 Development of the New Zealand Dairy Industry	28
5.2 Current Dairy Industry Structure	29
6. PAYMENT FOR MILK	33
6.1 Development of New Zealand Milk Payment Systems	33
6.2 Current New Zealand Milk Payment System	34
7. THE DAIRY FARM MODEL	40
7.1 Objective of the Model	41
7.2 Basis of the Model	41
7.3 Derivation of the Model	43
7.4 Testing the Model	58
8. METHODOLOGY	60
9. RESULTS	63
10. DISCUSSION	74
10.1 Effect of selected Jersey sires on milk yield and composition	75
10.2 Effect of selected Jersey sires on cow liveweight	78
10.3 Effect of selected Jersey sires on stocking rate	81

TABLE OF CONTENTS (Contd.)

10.4	Effect of selected Jersey sires on marginal profit per cow	84
10.5	Effect of selected Jersey sires on marginal profit per hectare	86
10.6	Effect of artificial insemination costs on sire profitability	90
10.7	Sensitivity of the model	92
10.8	Trends in milk yield and composition per cow	96
10.9	Trends in milk supply and composition within the industry	108
10.10	Payment for milk	117
11.	CONCLUSIONS	121
12.	SUMMARY	123
13.	REFERENCES	124
14.	APPENDICES	
I.	Lookup tables for predicting the marginal profitability of proven sires	
II.	Calculation of genetic gain in the New Zealand Jersey population	

LIST OF TABLES

Table 1.1	Milkfat and protein values for New Zealand dairy product sales
Table 3.1.1	Effect of pasture allowance on milk yield and composition
Table 3.2.1	Lactation performance for high and low BI Friesian cows
Table 3.3.1	The effect of average herd BI on the genetic superiority of daughters
Table 3.3.2	Milkfat production of high and low BI Friesian cows
Table 3.4.1	Summary of correlations between body size and milk production
Table 3.4.2	Estimated correlations between BV's and selection indices for milk and milkfat yields in Holstein Friesian cattle
Table 4.2.1	The effect of using superior sires on production per hectare
Table 4.3.1	Effect of bodyweight on the efficiency of milk production per cow
Table 5.2.1	Volume of dairy products manufactured in New Zealand
Table 6.2.1	Milk component prices
Table 6.2.2	The effect of two systems of milk payment on returns to the farmer
Table 6.2.3	Estimated genetic and phenotypic correlations between milk and milk solids
Table 6.2.4	Changes in farmer income under an a + b-c milk payment system
Table 7.3.1	Milk component prices received by suppliers of Tui Milk Products
Table 7.3.2	Cull cows price schedule
Table 7.3.3	Calculation of dollar return per carcass for herd with average liveweight = 320kg
Table 7.3.4	Calves price schedule
Table 7.3.5	Input costs per cow
Table 7.3.6	Production averages by age (Jersey)
Table 7.3.7	Calculating average herd production
Table 7.4.1	Comparison of actual profit and predicted profit per Jersey cow
Table 8.1	Selected high protein BI Jersey sires used in the study
Table 9.1	The effect of selected high protein BI Jersey sires on farm production and profitability
Table 9.2	The effect of selected high protein BI Jersey sires on milk yield and composition per cow in the herd
Table 9.3	The effect of selected high protein BI Jersey sires on stocking rate, liveweight per cow and marginal profit per cow and per hectare
Table 9.4	The effect of changing fat prices on marginal profit per hectare
Table 9.5	The effect of changing protein prices on marginal profit per hectare
Table 9.6	The effect of changing milk volume charges on marginal profit per hectare
Table 9.7	The effect of changing carcass prices on marginal profit per hectare
Table 9.8	Marginal profit per hectare from using Jersey sires of different protein BI
Table 10.2.1	Estimated daughter liveweights of selected sires using T.O.P records and weighed records

Table 10.4.1	The influence of sire BI and daughter liveweight on marginal profit per cow in the herd
Table 10.5.1	The influence of sire BI and daughter liveweight on marginal profit per hectare
Table 10.6.1	Profitability per hectare of selected Jersey sires using fixed and actual semen prices
Table 10.7.1	Estimated partial efficiencies of milk component synthesis
Table 10.7.2	The calculated net energy content of milk using two different methods
Table 10.8.1	Calculated annual genetic gains in yield and liveweight traits for New Zealand Jersey cattle
Table 10.8.2	Average genetic gain per year achieved in the US Jersey population since 1975
Table 10.8.3	Predicted change in annual yields of fat, protein, milk and milk solids concentration for the average Jersey cow under New Zealand rates of genetic gain
Table 10.8.4	Predicted change in annual yields of fat, protein, milk and milk solids concentration for the average Jersey cow under US rates of genetic gain
Table 10.8.5	The effect of predicted changes in average Jersey cow milk composition under New Zealand rates of genetic gain on achievable stocking rate, profit per cow and profit per hectare
Table 10.8.6	The effect of predicted changes in average Jersey cow milk composition under US rates of genetic gain on achievable stocking rate, profit per cow and profit per hectare
Table 10.9.1	Predicted changes in total yields of milk components, milk solids concentration and protein:fat ratio in the New Zealand Jersey population under New Zealand rates of genetic gain
Table 10.9.2	Predicted changes in total yields of milk components, milk solids concentration and protein:fat ratio in the New Zealand Jersey population under US rates of genetic gain
Table 10.9.3	Production history of the New Zealand Dairy Group of Companies
Table 10.9.4	Predicted increases in the supply of milk and milk solids to the New Zealand Dairy Group of Companies over the next 30 years of genetic improvement
Table 10.9.5	Estimates of annual supply increases for the New Zealand Dairy Group of Companies under various scenarios
Table 10.10.1	Gross milk returns of the average New Zealand and US sired Jersey daughter over the next 30 years

LIST OF FIGURES

- Figure 2.1 The key components of profit per hectare
- Figure 2.2 The key components of profit per cow
- Figure 3.1.1 The relationship between feed intake, milk yield and liveweight change
- Figure 3.1.2 The effect of herbage allowance on milk yield per cow
- Figure 3.2.1 Relationship between energy intake and energy requirement for lactation
- Figure 3.3.1 Herd average BI with yearling AB and selection relative to sire and herd BI from standard policies
- Figure 3.3.2 Relative efficiencies of high and low BI Jersey cows during lactation
- Figure 4.2.1 Performance of high and low BI Jersey cows at different stocking rates
- Figure 5.2.1 Number of suppliers vs average herd size
- Figure 5.2.2 Percent of industry milk production used in manufacturing
- Figure 6.2.1 Relationship between protein% and fat% for 4400 NZDGC suppliers
- Figure 6.2.2 The relationship between protein% and fat% of suppliers whose income changed under the a+b-c milk payment system
- Figure 7.3.1 The normal distribution curve
- Figure 7.3.2 Example of a standard normal distribution table
- Figure 7.3.3 Normal distribution curve with $\mu = 160\text{kg}$ and $\sigma = 40\text{kg}$
- Figure 10.1.1 Relationship between selected sire protein BI and fat yield per cow in the herd
- Figure 10.1.2 Relationship between selected sire protein BI and milk yield per cow in the herd
- Figure 10.2.1 Relationship between selected sire protein BI and average daughter liveweight
- Figure 10.3.1 Relationship between selected sire protein BI and stocking rate
- Figure 10.4.1 Relationship between selected sire protein BI and marginal profit per cow in the herd
- Figure 10.5.1 Relationship between selected sire protein BI and marginal profit per hectare
- Figure 10.5.2 The relationship between sire protein BI, average daughter liveweight and marginal profit per hectare
- Figure 10.8.1 Genetic trends in yields of fat, protein and milk in US Jersey cattle
- Figure 10.8.2 Predicted trends in yields of milk and milk solids per cow using New Zealand or US sires
- Figure 10.8.3 Predicted trends in milk composition using New Zealand or US sires
- Figure 10.8.4 Predicted trends in stocking rate and profitability using New Zealand or US sires
- Figure 10.9.1 Total milkfat processed per month by New Zealand dairy factories