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Effects of milkfat yield and conformation traits on retention for a second lactation of Friesian and Jersey-sired cows

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ABSTRACT

The relative importance of the currently recorded large number of descriptive conformation traits and of milkfat yield on retention for a second lactation of 6645 Friesian-sired and 5709 Jersey-sired heifers was examined. In a linear multiple regression model, the effect of heifers deviating from the 'normal' conformation for a certain trait on the retention rate was used as an indicator for the relative importance of the trait. Milkfat yield was by far the most important trait for both breeds. Only a small number of conformation traits describing udder and teats influenced the retention rate significantly. The farmer with Jersey cows appeared to consider more conformation traits as important than the owner of Friesian cows. The results suggest the inclusion of only the important conformation traits describing udder and teats as potential traits in the selection of profitable dairy cattle in New Zealand to retain a high genetic response for milkfat yield.

Keywords Conformation; milkfat yield; Friesian; Jersey; stayability; survival rate; linear multiple regression; pasture based production system.

INTRODUCTION

Conformation of dairy cattle received considerable attention in the past owing to the belief that conformation traits could be used to predict the production ability of an animal. Today more accurate estimates of producing ability, such as production indices and breeding indices, are widely accepted and consequently the value and importance of conformation traits should be re-evaluated.

Overseas studies concerning the importance of conformation traits generally have involved concentrate-fed cows kept in confinement and selected for milk yield (Van Vleck *et al.*, 1969; Grantham *et al.*, 1974; Honette *et al.*, 1980) and information for pasture-fed cows selected for milkfat yield is scarce.

The objective of this study was to evaluate the relative importance of milkfat yield and conformation traits to dairy farmers operating pasture based milkfat production systems. In a linear multiple regression, the effect that heifers deviating for a certain trait from the 'normal' classification had on the retention rate (the percentage of cows retained after the first lactation) was used to assess the importance of the traits.

MATERIALS AND METHODS

The final data set included 6645 heifers sired by 185 Friesian bulls in 238 herds and 5709 heifers sired by 179 Jersey bulls in 231 herds, all being commercial seasonal supply herds distributed throughout New Zealand. Of the Friesian-sired heifers (Friesians), 13%, and of the Jersey-sired heifers (Jerseys), 10% were crossbred animals. The cows were born in 3 consecutive years from 1977 and calved at the age of 2 years during spring.

Editing had excluded cows which died (avoiding the effect of involuntary culling in the analysis), did not have records for all traits or belonged to herds that did not test the season following their first lactation. A cow was coded 'retained' if it was herd tested a second lactation and 'not retained' if it was culled during the first lactation or if it did not appear during the following season despite the herd being production recorded. This definition was used since the last record of an animal did not always reflect the fate of the cow accurately.

Milkfat yield for the first lactation was estimated from 4-weekly samples of milk recording through the national milk recording scheme. Conformation traits (Table 1) were assessed on each animal during mid-lactation by inspectors trained at workshops to standardise scoring. Each assessment was expressed with a descriptive code and represented the joint judgement of 2 inspectors. A final assessment was given for udder and overall conformation using an ordered category with 5 classes.

A linear multiple regression was calculated, separately within breed of sire, with retention as the response variable and milkfat yield and conformation traits as explanatory variables using least-squares procedures. For each descriptive conformation trait, dummy variables were assigned for the different categories (Searle, 1971). Final assessments for udder and overall conformation were treated as continuous variables with numerical codes assigned from '1'—'very good' to '5'—'unsatisfactory'. Forward, backward and stepwise regression selection techniques from the Statistical Analysis System (SAS) were used to identify variables whose partial F-statistic had a significance level equal to or less than 0.05. The 'best' multiple regression model was determined using Mallow's Cp as criterion (Daniel and Wood, 1980). Standard partial regression coefficients of the traits in the 'best' model were used as indicators for the relative importance of different traits on the retention rate.

TABLE 1 Conformation traits and their categories.

Jaw: normal, undershot (brachygnathia inferior) or suspicious (condition suspected but not confirmed by opening the jaw);
Front and rear feet: normal, flat, bilateral symmetrical overgrowth, long toes;
Legs—side view: normal, straight or sickled;
Legs—rear view: normal or hocky;
Rump—side view: normal, rough top line, loins down, slopey, very slopey, high tail, pins level/tail down, pins down;
Rump—rear view: normal or narrow;
Udder size: normal, small, big or floppy;
Slope of udder floor: normal, front teats high or rear tests high;
Udder segmentation—side view: normal, quartered or flat;
Udder segmentation—rear view: normal or level (this trait describes the strength of the suspensory ligament);
Fore udder length: normal, long or short;
Fore udder shape: normal or bulgy;
Rear udder catch: normal, high, low;
Rear udder shape: normal, bulgy or cut away;
Placement of front and rear teats: normal, wide or very wide;
Angle of front and rear teats: normal, outwards, acute outwards, backwards, forwards or inwards;
Teat size: normal, fat, thin, long, short or uneven;
Size of animal: normal, small or big;
Final assessment for udder and conformation: very good, above average, average, below average or unsatisfactory;

RESULTS

Milkfat yield was normally distributed with a mean of 126 kg and 127 kg for Friesian and Jersey heifers, respectively, and a standard deviation of 36 kg. The overall retention rate, the percentage of heifers surviving for a second lactation, was 82.9% for Friesians and 81.8% for Jerseys. A highly significant ($P<0.0001$) relationship existed between milkfat yield and retention rate, and the product-moment correlations were 0.37 for Friesians and 0.41 for Jerseys.

The conformation traits displayed limited phenotypic dispersion. That is, more than 90% of the heifers were classified as 'normal', except in the final assessment for udder and overall conformation. Differences between breeds occurred for undershot jaws with a 4 times higher frequency for Jerseys. Retention rates did not differ among heifers in the different categories for most of the conformation traits. Table 2 shows the frequency for different categories of those conformation traits with a significant effect on retention rate for Friesian and(or) Jersey heifers and the retention rate within each category. An example of a conformation trait with a significantly different retention rate is the final udder assessment (Table 2). Here, the favourable categories have markedly higher retention rates than the unfavourable categories with a difference of 36% units in retention rate between the most and the least favourable category for Jersey cows.

In multiple regressions, only 2 conformation traits significantly affected retention rate in Friesian heifers, in contrast to 9 conformation traits for Jersey heifers (Table 3). Partial regression coefficients for both Friesian and Jersey heifers were positive for milkfat and negative for 'not normal' conformation trait classifications. The only exception was a positive regression coefficient for Jerseys with wide placed rear teats. With a 10 kg increase in milkfat yield, retention rate increased by 3.8% for Friesian and 4.2% for Jersey heifers, if all other traits were assumed unchanged. Similarly, with a change from an 'average' to a 'below average' classification for udder conformation, retention rate decreased by 2.7% for Friesians and 2.4% for Jerseys.

The standardised regression coefficient estimates (Table 3) show the relative importance of different traits on the retention rate. Milkfat yield was by far the most important trait and the most important conformation trait, udder assessment, achieved only 16% and 13% of the importance of milkfat yield for Friesians and Jerseys, respectively. The inclusion of the significant ($P<0.05$) conformation traits in addition to the variable milkfat yield increased the squared multiple correlation coefficient by 5% (to 12%) for Friesian heifers and by 8% (to 16%) for Jersey heifers.

DISCUSSION

The explanation of variation in retention rate by milkfat yield, in line with the payment and selection for milkfat yield in New Zealand, has also been reported by Wickham (1979). In contrast, studies based on dairy cattle populations selected for milk yield (Honette *et al.*, 1980; DeLorenzo and Everett, 1982; Bar-Anan and Ron, 1983) revealed milk yield to be the most important trait determining culling rate and stayability.

Similarly, the retention rate in this study is comparable with the average of 79% of cows herd testing at least once during the second lactation reported by Wickham *et al.* (1977), but Everett *et al.* (1976) published sire averages for 36-month stayability of daughters of 91.5%. Different culling practices for the 2 production systems and data editing procedures might explain the differences. The squared multiple correlation coefficient and the regression coefficients

TABLE 2 Frequency F(%) of different categories for significant conformation traits and retention rate S(%) within each category

	Friesian		Jersey	
	F	S	F	S
Jaws				
Normal	98.6	83	95.4	82
Suspicious	1.1	84	3.4	74
Undershot	0.3	82	1.2	56
Udder segmentation- rear view				
Normal	99.6	83	99.3	82
Level	0.4	63	0.7	62
Length of fore udder				
Normal	84.6	84	90.1	83
Long	1.1	79	3.3	81
Short	14.3	78	6.7	70
Placement of front teats				
Normal	48.8	83	61.6	82
Wide	49.1	83	37.1	82
Very wide	2.1	70	1.3	64
Placement of rear teats				
Normal	90.7	83	91.7	82
Close	6.2	86	3.0	78
Wide	3.0	75	5.0	85
Very wide	0.1	25	0.3	53
Angle of front teats				
Normal	69.7	83	72.2	82
Outwards	26.2	82	25.2	82
Acute outwards	1.1	72	1.2	65
Backwards	0.4	88	0.8	82
Inwards	0.1	80	0.1	80
Forwards	2.5	83	0.6	57
Angle of rear teats				
Normal	87.0	83	84.8	82
Outwards	6.4	76	7.7	81
Acute outwards	0.3	56	0.3	47
Forwards	2.5	84	0.7	67
Inwards	3.3	88	3.4	80
Backwards	0.6	85	3.1	77
Teat size				
Normal	90.2	83	90.8	82
Fat	0.6	85	0.1	62
Long	2.0	81	1.2	84
Thin	1.4	77	0.9	78
Short	3.4	82	3.9	82
Uneven	2.4	81	3.0	73
Udder overall				
Very good	1.2	91	2.8	93
Above average	19.6	87	25.0	84
Average	52.0	84	47.7	82
Below average	26.0	79	23.0	78
Unsatisfactory	1.3	62	1.5	57

agree with DeLorenzo and Everett (1982).

The relatively minor importance of the conformation traits in comparison to production traits is also stated in previous publications (Van Vleck *et al.*, 1969; White, 1974; Everett *et al.*, 1976; Honette *et al.*, 1980; DeLorenzo and Everett, 1982; Burnside *et al.*, 1984). Most workers agree that udder and teat characteristics are the most influential conformation traits. The important conformation traits can be summarised as those that adversely affect the milking routine. For example, it is more difficult to put the milking machine cups on if the front teats angle forwards. However, the reason for the positive value for wide placed rear teats is not clear.

Differences in culling and selection practices between the Friesian and the Jersey population might be indicated by the difference in the number of significant conformation traits and in the greater increase in Jerseys than in Friesians in the proportion of variation accounted for (R^2) when the conformation traits were included. Norman and Van Vleck (1972) reported a reversed situation. Conformation traits increased the multiple correlation coefficient (in addition to milk and fat yield) for predicting lifetime value of product by 0.08 for Friesian cows but only 0.02 for Jerseys.

Retention rate or stayability is a simple indicator for longevity (Burnside *et al.*, 1984) and extrapolating on present results the significant variables would be predictors for longevity. The frequency of undershot jaws, considered to be a latent recessive trait (Roberts, 1971) in the Jersey population, and the high negative value placed on it through culling decisions point to an existing breed difference for this trait.

Because genetic response increases with a decrease in the number of traits included in the selection objective, the results of this study support the recommendation that only the important conformation traits describing udder and teats be recorded and considered as potential traits in the selection of profitable dairy cattle in New Zealand.

REFERENCES

Bar-Anan R.; Ron M. 1983. Genetic correlations among progeny groups for type traits, milk yield, yield persistency and milking rates. *Journal of dairy science* **66:** 2438-2440.

Burnside E.B.; McClintock A.E.; Hammond K. 1984. Type, production and longevity in dairy cattle: a review. *Animal breeding abstracts* **52:** 711-719.

Daniel C.; Wood F.S. 1980. *Fitting equations to data.* Second Edition, John Wiley and Sons, Inc. New York.

DeLorenzo M.A.; Everett R.W. 1982. Relationships between milk and fat production, type, and stayability in Holstein sire evaluation. *Journal of dairy science* **65:** 1277-1285.

Everett R.W.; Keown J.R.; Clapp E.E. 1976. Relationships among type, production and stayability in Holstein cattle. *Journal of dairy science* **59:** 1505-1510.

Grantham J.A.; White J.M.; Vinson W.E.; Kliewer R.H. 1974. Genetic relationships between milk production and type in Holsteins. *Journal of dairy science* **57:** 1483-1488.

Honette J.E.; Vinson W.E.; White J.M.; Kliewer R.H. 1980. Prediction of herdlife and lifetime production from first lactation, production and individual type traits in Holstein cows. *Journal of dairy science* **63:** 816-824.

Norman H.D.; Van Vleck L.D. 1972. Type appraisal: III. Relationships of first lactation production and type traits with lifetime performance. *Journal of dairy science* **55:** 1726-1734.

Roberts S.J. 1971 *Veterinary obstetrics and genital diseases* (Theriogenology). Ed. S.J. Roberts, Ithaca, New York.

Searle S.R. 1971. *Linear models.* Second Edition, New York, John Wiley and Sons, Inc.

Van Vleck L.D.; Filkins D.B.; Carter H.W.; Hart C.L. 1969. Relationship between type traits and longevity of daughters of New York Holstein sires. *Journal of dairy science* **57:** 1823-1830.

White J.M. 1974. Genetic parameters of conformational and managemental traits. *Journal of dairy science* **57:** 1267-1278.

Wickham B.W. 1979. Genetic parameters and economic values of traits other than production. *Proceedings of the New Zealand Society of Animal Production* **39:** 180-193.

Wickham B.W.; Belsey M.A.; Jackson R.G.; Rumball W. 1977. Genetic improvement—some aspects of costs and benefits to the New Zealand livestock industry. I. Dairy cattle. *New Zealand agricultural science* **11:** 54-64.

TABLE 3 Partial and standardised partial regression coefficients of retention rate on milkfat yield and conformation traits for Friesians (R^2 = 0.12, error mean square = 0.12) and Jerseys (R^2 = 0.16, error mean square = 0.12).

Variable	Regression coefficient	Standard error	Standardised coefficient
Friesian			
Intercept	0.43084 ***	0.02634	0
Milkfat yield	0.00378 ***	0.00013	0.33438
Udder	-0.02743 ***	0.00600	0.05396
Very wide placed front treats	0.10448 ***	0.03068	-0.04001
Jersey			
Intercept	0.35891 ***	0.02661	0
Milkfat yield	0.00420 ***	0.00014	0.37133
Udder	-0.02362 ***	0.00630	-0.04932
Undershot jaw	-0.17807 ***	0.04434	-0.04889
Suspicious jaw	-0.07701 **	0.02841	-0.03299
Short fore udder	-0.05574 **	0.01939	-0.03600
Weak suspensory ligament	-0.16392 **	0.05609	-0.03625
Forwards angling front teats	-0.15937 **	0.06035	0.03219
Backwards angling rear teats	-0.06248 *	0.02719	-0.02818
Wide placed rear teats	0.06000 **	0.02293	0.03370
Uneven teat size	-0.06144 *	0.02771	-0.02718