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D. P. Berry
Teagasc, Ireland

B. L. Harris
Livestock Improvement, New Zealand

A. M. Winkelman
Livestock Improvement, New Zealand

W. Montgomerie
Animal Evaluation Unit, New Zealand

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Relationships between traits other than production and longevity in New Zealand dairy cows

D.P. Berry¹, B.L. Harris², A.M. Winkelman² and W. Montgomerie³

¹*Teagasc, Moorepark Research Centre, Fermoy, Co. Cork, Ireland, Email: dberry@moorepark.teagasc.ie*

²*Livestock Improvement, Private Bag 3016, Hamilton, New Zealand* ³*Animal Evaluation Unit, Private Bag 3016, Hamilton, New Zealand.*

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Introduction Reduced longevity in dairy cattle is recognised world-wide to be a considerable cost to the dairy industry, especially in seasonal calving grazing production environments. The objective of the present study was to investigate the relationships among traits other than production (TOP) and true and functional longevity in purebred and crossbred New Zealand cows from commercial herds operating seasonal calving grass-based systems of milk production. This study made use of survival analysis, a technique used to allow the inclusion of incomplete (i.e., censored) longevity data in the analysis while simultaneously accounting for the skewed distribution of longevity data and the changing environmental and genetic effects over time.

Materials and methods Data on 16 TOP (4 management traits and 12 conformation traits) on primiparous cows were extracted from the New Zealand national database. Snell's transformations were used to minimise skewness and kurtosis in TOP scores. Each TOP was pre-adjusted for age at calving (nested within breed) and stage of lactation. Residuals were normalised within contemporary group of herd-year-season of calving. Normalised residuals were coded as a qualitative variable with 20 levels. Longevity data, including calving dates, date of culling and reasons for culling were extracted from the national database on the 15 March 2004. Records were censored if the cow was spring calving and had an official record after 1 June 2003 but no subsequent culling record; records of autumn calving cows were censored if the animal had an official record after 1 January 2003 but no culling record. Animals were also treated as censored if they entered a contemporary group with less than four non-censored records. Only animals residing in sire proving herds (indicative of commercial herds) were retained in the analysis. In total, 259,280 animals were included in the analysis. The survival analysis was undertaken using a proportional hazards Cox model and was stratified by breed; breed was defined as Holstein-Friesian, Jersey or crossbred. The hazard function was described by the baseline hazard function, herd-year contemporary group (class variable [CL]; time dependent [TD]), pedigree registration status (CL; time independent [TI]), age at first calving (CL; TI), heterosis (CL; TI), proportion of overseas Holstein-Friesian, New Zealand Holstein-Friesian and Jersey genes (CL; TI), period of last calving (CL; TI), type score relative to the contemporary group (CL; TI). Production values (CL; TI) and milk production variables (CL; TD) were only included in the analysis of functional longevity. Tests of significance for explanatory variables were based on the Akaike's information criterion.

Results Risk of being culled was higher in later calving cows, non-registered cows with lower milk production. The risk of culling also increased as the proportion of overseas Holstein-Friesian genes increased, except at high levels >80% when it decreased again. All TOP affected ($P < 0.001$) true and functional longevity. Of the TOP, farmer opinion of the cow had the greatest influence on true and functional longevity. Two composite traits, overall udder and dairy conformation, also exhibited some of the strongest influences on cow longevity. Of the individual TOP describing the conformation of the cow, the udder-related traits had the largest influence on longevity. Rump angle, rump width and legs had least influence on longevity. Across all management traits, cows with strongly undesirable scores were at a higher risk of being culled than cows of intermediate scores, but cows with high scores conferred no additional advantage in longevity. The risk of culling in cows of poor farmer opinion was 1.2 to 2.5 times that of a cow of intermediate farmer opinion. A similar trend of lower scores being associated with a higher risk of culling was observed for stature, udder support, fore udder attachment, rear udder height and dairy conformation. Legs showed an opposite trend; a higher risk of culling existed in cows with higher legs scores (i.e., more sickled legs). Capacity, rump angle, rump width and teat placement exhibited intermediate optima with an increased risk of culling observed in extreme scores.

Conclusions Results from this study indicate a strong association between farmer opinion, scored in first lactation, and longevity. Other farmer scored traits and udder-related traits were also strongly related to true and functional longevity in commercial herds. The results clearly demonstrate the suitability of TOP, especially farmer scored traits, as phenotypic indicators of the ability of the cow to delay voluntary and involuntary culling in grass based system of production. Several traits, most notably legs and teat placement, exhibited an intermediate optimum to avoid voluntary/involuntary culling.

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