



Accuracy of MACE Evaluations

Interbull has been providing international bull evaluations for more than ten years now and the resulting Multiple-trait Across Country Evaluations (MACE) have been available in Canada and many other countries to assist genetic selection decisions in a global market place. Since MACE evaluations are the primary tool for identifying superior sires that were first proven outside of Canada, a recent study at Canadian Dairy Network (CDN) was aimed at evaluating how good they were at predicting each bull's subsequent official domestic proof based on daughters in Canadian herds.

Unique Analysis

Every proof round, various A.I. organizations identify sires proven outside of Canada for semen importation and usage in Canadian dairy herds. In addition to the bull's genetic evaluation in the country where they are first proven, their MACE evaluation is also usually considered before importing semen into Canada. In any event, MACE evaluations are the primary tool used to market the semen in Canada, which allows producers to compare their proof profile to that of other bulls proven domestically. The CDN analysis included a group of 152 foreign proven bulls that ended up receiving their first official LPI between May 2001 and August 2006, of which 90% were first proven in the United States and the remainder originated from Europe. For each bull, their MACE evaluations from four, three, two and one year prior to receiving their first official LPI were retrieved from the CDN database as well as the domestic proof information for one year later.

Given that Canada uses a rolling genetic base that is updated annually, bull proofs over time are not easily comparable without proper pre-adjustment. In addition to genetic base updates, changes in genetic evaluation methodologies may also cause an average shift upwards or downwards in bull proofs that complicates comparisons across genetic evaluation runs. The CDN analysis used a group of reference bulls with relatively little change in the number of daughters included in their proof from 1998 to 2007 and therefore adjusted all proofs to the August 2007 genetic base. This approach for comparison analysis is a unique and novel way to evaluate the accuracy of MACE evaluations as predictors of future domestic proofs in Canada.

Correlations

Table 1 provides correlations for major traits between proofs at the bull's first official LPI with MACE evaluations at four, three, two and one year before and with domestic proofs one year after. As expected, proof correlations between consecutive domestic evaluations were highest and, in general, correlations progressively increased as the MACE evaluation date got closer to the date at first official LPI. When all traits are considered, there are a dozen with correlations of .70 to .89 and nine others that fall between .58 and .68, while the traits with the lowest correlations include Udder Depth (.51), Rear Legs Rear View (.49), LPI (.46), Dairy Strength (.46) and Feet & Legs (.30). Among these five traits, Udder Depth, Rear Legs Rear View and Dairy Strength were added at some time during the time

period analyzed while LPI and Dairy Strength went through significant changes in definition during the years. Feet & Legs has amongst the lowest average genetic correlations across countries, which contributes to the poorer predictability of the MACE evaluations compared to the eventual domestic proof.

Table 1: Correlations of Proofs at First Official LPI with MACE Evaluations 4, 3, 2 and 1 Year Before and with Domestic Proofs 1 Year After

Trait	4 Years Before	3 Years Before	2 Years Before	1 Year Before	1 Year After
LPI	0.46	0.54	0.54	0.58	0.88
Milk	0.74	0.79	0.80	0.81	0.94
Fat	0.72	0.77	0.77	0.81	0.93
Protein	0.73	0.76	0.75	0.79	0.93
Fat Deviation	0.88	0.90	0.91	0.90	0.97
Protein Deviation	0.89	0.91	0.91	0.91	0.97
Somatic Cell Score	0.72	0.60	0.70	0.68	0.81
Conformation	0.63	0.67	0.69	0.72	0.94
Mammary System	0.68	0.71	0.72	0.77	0.94
Dairy Strength	0.46	0.53	0.59	0.60	0.89
Feet & Legs	0.30	0.35	0.32	0.38	0.92
Rump	0.59	0.66	0.65	0.66	0.94

Average Predictability

While correlations are a useful measure of how well the MACE evaluations predict the eventual domestic proof in Canada, they do not identify if a general overestimation or underestimation exists. To answer this question, Table 2 shows the average proof change from MACE evaluations for each interval before the first official LPI as well as the average proof change one year later. MACE evaluations seem to over predict the eventual proof at the first official LPI for several important traits including LPI, Fat Yield, Conformation, Mammary System, Dairy Strength and Rump. For other traits, the MACE evaluations appear to be an unbiased prediction. During the year following receipt of the first official LPI, average proof changes are quite negligible with the exception of Fat and Protein yields.

Table 2: Average Proof Change from MACE Evaluations 4, 3, 2 and 1 Year Before First Official LPI to the First Official LPI and to 1 Year After

Trait	4 Years Before	3 Years Before	2 Years Before	1 Year Before	1 Year After
LPI	-102	-130	-162	-175	7
Milk	38	13	32	27	-9
Fat	-6.3	-5.3	-3.7	-1.5	-1.8
Protein	0.4	0.6	1.1	0.6	-1.1
Fat Deviation	-0.06	-0.04	-0.03	-0.01	-0.01
Protein Deviation	-0.01	0.00	0.00	0.00	-0.01
Somatic Cell Score	-0.01	0.05	0.03	0.03	-0.02
Conformation	-2.9	-2.4	-2.2	-1.8	0.2
Mammary System	-2.4	-2.0	-1.8	-1.7	0.4
Dairy Strength	-2.2	-1.7	-1.3	-0.8	-0.3
Feet & Legs	0.5	0.1	-0.7	-0.9	0.5
Rump	-2.7	-2.7	-2.5	-2.1	0.0

Summary

The analysis of MACE evaluations as predictors of future official domestic evaluations showed varying degrees of accuracy as reflected by the proof correlations from four, three, two and one year prior to the first official LPI. Traits with low proof correlations across time are often those added as new traits during the time period studied and/or are traits that combine several other traits, such as LPI. In addition, for LPI, the formula has changed on various occasions during the time period studied and not all traits included in the LPI formula had MACE evaluations available once they were included. MACE evaluations for foreign proven bulls are also highly dependent upon changes in the domestic evaluation in the country of first proof, changes to the estimates of genetic correlations across countries and methodology changes at Interbull. This study clearly showed the need to improve the accuracy of MACE evaluations for some traits, especially LPI, in an effort to reduce the over prediction compared to eventual official domestic proofs.

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