Réseau laitier canadien
Canadian Dairy Network

Genetic Gains Achieved

Canada's national selection index, the Lifetime Profit Index (LPI) aims to identify cows that can sustain high production over a long lifetime while ensuring that costs are minimized through improvements to health and fertility. Since being introduced in 1991, this overall selection goal has evolved and was most recently enhanced in 2008, when emphasis on Daughter Fertility (DF) was increased from 5% to 10%. The purpose of this discussion is to describe genetic progress attained in economically important traits in Holsteins and to identify areas of concern that may be addressed by changing emphasis to existing traits or by including new traits in the selection goal. Although the Canadian Dairy Network (CDN) calculates breeding values for more than 70 individual traits, the LPI remains to be the primary genetic selection tool utilized by the industry and producers.

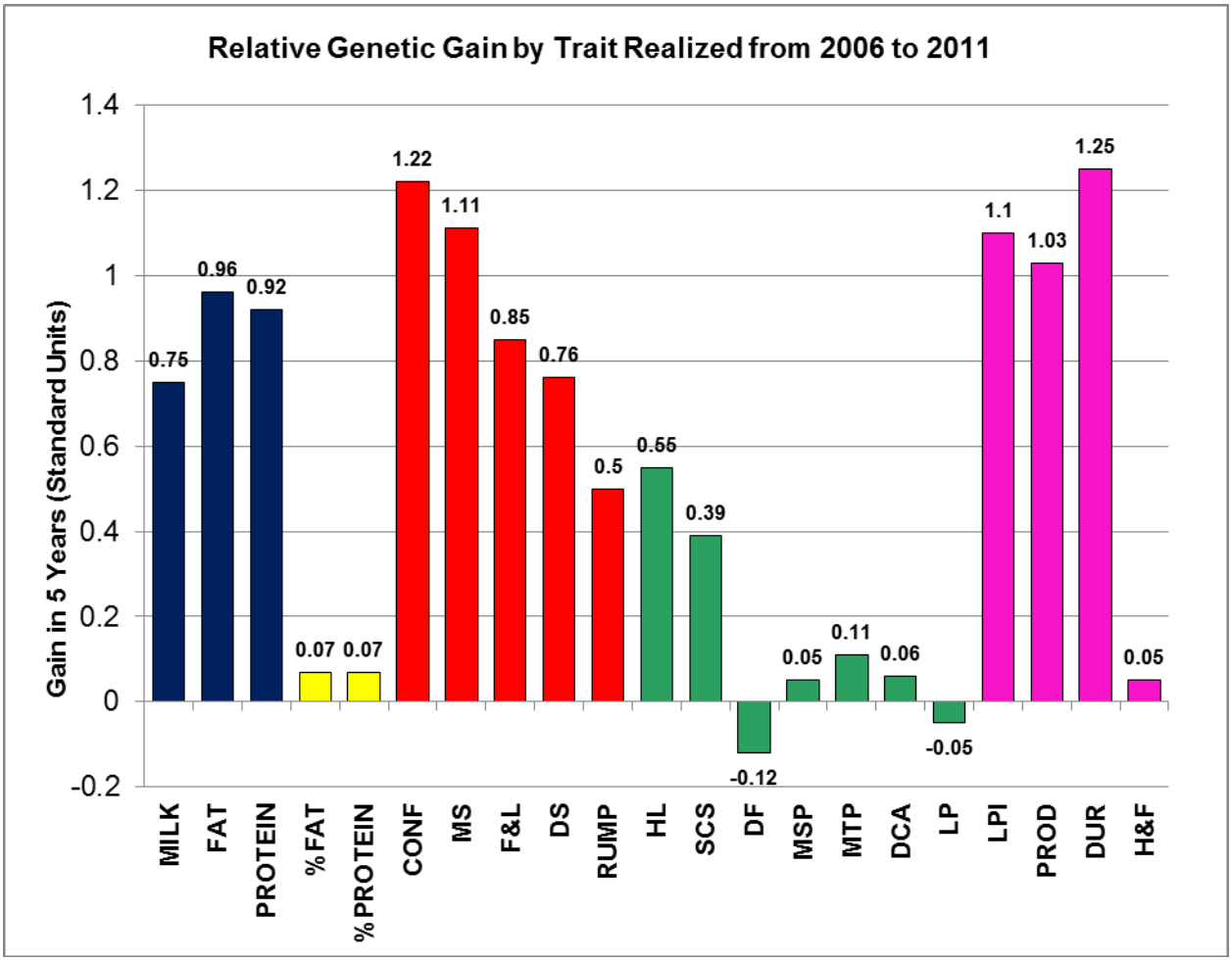
Relative emphasis of individual traits included in the Holstein LPI is shown below. Over its existence, the weight of type in the formula has decreased from 40% to 27%, and production has decreased from 60% to 51% in order to make room for new traits such as Herd Life, Somatic Cell Score and DF. In 2005, some emphasis on protein and fat deviation (a total of 5% of the production component) was included to balance selection for yield and changes to the milk pricing formula. In every case, when increased importance was placed on the Health & Fertility component of the LPI, weight was subsequently removed from Production and Durability by maintaining the original relative emphasis between these two components of 60:40. A constant challenge has always been the desire to increase productive capability in the breed in combination with making improvements in reproductive efficiency. Genetically, these two goals are in constant competition and including them simultaneously in the selection index is the only way to make progress for both.

Table 1. LPI Formula for Holsteins

Production (51%)			Durability (34%)		Health & Fertility (15%)		
Protein (60%)	Yield	57%	Herd Life	20%	Udder Health 33%	SCS	20%
	Deviation	3%	Mammary System	40%		Udder Depth	10%
Fat (40%)	Yield	38%	Feet & Legs	30%		Milking Speed	3%
	Deviation	2%	Dairy Strength	10%	Daughter Fertility		67%

Genetic gain was calculated for several traits for females born in 1988 to 2011 and then standardized for comparison across traits. Relative genetic gain realized in the most recent 5 year period (2006 to 2011) is shown in the graph below. With the exception of

DF and Lactation Persistency (LP), every trait experienced some level of genetic improvement. The trait that realized the most significant growth was Conformation, which increased by 1.22 standard units in 5 years. Bulls available for selection in recent years have been exceptional for type and the genetic gains attained in the female population reflect that trend. Close behind, Mammary System increased by 1.11 standard units and subsequently, the Durability component of the LPI increased by 1.25 standard units. Rump experienced the least amount of improvement compared to other major type traits and overall Conformation. Rump is the only major type trait not directly included in the LPI formula. Genetic progress in fat yield was larger than for protein yield. In functional traits, Herd Life showed the largest gains, followed closely by Somatic Cell Score.



Daughter Fertility showed a slight loss of 0.12 standard units over the last 5 years. This decline was less severe than the deterioration of 0.34 points seen in the previous 5 year period (2001 – 2006). Inclusion of DF in the LPI (beginning in 2005) seems to have slowed genetic decline in this important trait but not to the extent that the trend has flat-lined or even reversed towards making genetic progress. In order to make more significant genetic progress in Daughter Fertility some aggressive steps could be taken. One option would be to increase the weight directly placed on DF in the LPI formula, for instance from 10% to 15%, thereby increasing the Health & Fertility component to 20% overall. By doing so, weight on other vital traits subsequently needs to be removed. Many would argue the merits and disadvantages of decreasing emphasis on either the

Production or Durability components, or both. Decreasing the relative weight on the production component would boost genetic progress in DF even further since these traits are negatively correlated. A second option to improve progress in DF would be to maintain the current ratio of 51:34:15 among the three LPI components, but increase emphasis on traits within the components, such as protein deviation and Herd Life, which are strongly and favourably correlated to reproductive efficiency. Both techniques used in the most effective combination would maximize the genetic gains attainable. Progress in DF must always be weighed against the resulting loss in production or type due to antagonistic genetic relationships.

Summary

The Canadian Holstein showcases a unique balance of strength and dairy quality. Boasting an exceptional udder, Canadian Holsteins are world renowned for their functional conformation following decades of intense and successful selection for type. Heavy and widespread use of the national index (LPI) for selection and mating of candidate animals has resulted in huge improvements to many economically important traits, but more focus needs to be placed on the decline in Daughter Fertility. In order to quicken and heighten enhancements to reproductive efficiency in the breed, some loss of potential progress in traits such as milk production and type is expected. Investigations into how to balance genetic progress in conformation and longevity and maximizing the gains desperately needed in female fertility will be forthcoming this fall.

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