Genetic Progress at Herd Level

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At a national level there has been a long established genetic trend for increased milk production. This has been achieved through the introduction of the Holstein breed, the use of breeding technologies and indices such as £PIN (Profit Index) encouraging further selection for production. However, placing such emphasis on production alone has had implications for other traits leading to declines in fertility and longevity. In recent years, this has been addressed through the introduction of the Profitable Lifetime Index (£PLI) which is now starting to reverse the genetic trend in infertility and lower lifetime performance.

What is £PLI?

£PLI is a total merit index that combines a number of productive and non-productive traits with relevant economic weightings into a single figure. This allows sires to be ranked on their overall genetic merit. Around 45% of the weighting of £PLI is attributed to productive traits, i.e. milk, fat and protein yield (formerly £PIN) while the remaining 55% is attributed to non-productive traits including lifespan, fertility, somatic cell count, udder and locomotion. The top ranking sires generally have good figures for a range of productive and non-productive traits. However sires can be selected for their strengths in individual traits such as milk yield, milk protein%, fertility, lifespan or somatic cell count.

What is £PLI expected to deliver for non-productive traits at herd level?

a) Fertility: Although levels of herd fertility are more dependent on management than breeding, a number of traits including calving interval and non-return rate have been combined into a Fertility Index for use in selecting bulls. Fertility Index is a financial figure and typically ranges from -15 to +15. This has been available in all proof runs since May 2005. Daughters of a bull with an above average Fertility Index are predicted to have reduced calving intervals and increased non-return rates. Each one-point increase in Fertility Index, say from 1 to 2, is expected to decrease calving interval by half a day and improve non return rates by 0.5%.

b) Lifespan: The Lifespan PTA of sires are calculated from a range of sources including pedigree information and the dairy type traits (feet and legs composite, mammary composite), SCC and survival data of female relatives. Lifespan PTAs are expressed in lactations and typically range from -0.5 to +0.5. The daughters of a bull with a Lifespan PTA of 0.3 is expected to survive on average 0.3 lactations longer than the daughters of an average bull with a Lifespan PTA of zero.

c) Somatic Cell Count: The somatic cell count PTA is based on national milk recording records and is expressed as a percentage, typically ranging from -30 to +30. Sires with a negative SCC PTA are expected to reduce the SCC of their daughters compared to the average bull. Each 1% change in a sire's SCC PTA is predicted to change his daughters' SCC by 1% so the daughters of a bull with a SCC PTA of -10% would be expected to be 10% lower than daughters of a bull with a SCC PTA of zero. As there is a strong link between SCC and mastitis, the daughters of sires with a negative SCC PTA are expected to have reduced mastitis incidence.

Genetic progress at herd level

It is important to have a long-term breeding strategy with clear goals in mind, and select sires over a number of years that will meet these goals. Economic studies at AFBI have established that autumn calving herds in the 8,000-8,500 litre range are amongst the most profitable dairy

production systems in Northern Ireland. Therefore at Greenmount Campus, the aim of the 150-cow Future Herd is for cows to produce milk yields in this range with butterfat and protein targets of 4.10% and 3.50%, respectively to meet the demands of the Northern Ireland processing market. Aligned with these targets is an average lifetime yield of 40,000 litres per cow with fertility targets of 80% submission rate to first service and 50% conception rate.

In pedigree registered herds it is possible to monitor genetic progress over time, but this can also be done in non-pedigree milk recorded herds where the sire of individual cows is identified. At Greenmount there is a long-term breeding strategy to meet the production targets above and analysis of the milk recorded cows in the herd over the last 10 years allows us to see the genetic progress that has been made (Table 1). Together with details on current levels of production, this can also give direction for the future.

Table 1: *Average herd genetic merit of milk recorded cows in the Future Herd over time (based on their proofs in August 2011).*

	2001	**2006**	**2011**
£PLI	-44	+6	+63
PTA Milk	-290	-142	-135
PTA Butterfat %	+0.02	+0.06	+0.14
PTA Protein %	+0.04	+0.05	+0.08
Sire PTA Fertility	-2.8	-2.4	+0.3
Sire PTA Lifespan	-0.09	-0.06	+0.28
Sire PTA SCC	+3.8	+4.4	-6.9

Using herd genetic status as an aid to sire selection

Sire selection is an important decision as the sires selected today will determine the genetics of the cows you will be milking in 3-7 years time. Sire selection at Greenmount over the last 5 years has always started with an assessment of the genetic status of the milking herd each autumn. A Herd Genetic Report is available from the DairyCo Breeding+ website (www.dairyco.org.uk) giving the genetic proofs of all cows that have completed a lactation in the previous 12 months. More recently, this report has been made available by National Milk Records and United Dairy Farmers which can list the genetic merit of cows present at the last milk recording.

The average genetic merit of cows in the Future following the August 2011 is shown in Table 2. This Herd Genetic Summary will form the basis of sire selection this autumn where the PTAs of sires chosen should be equal to or higher than the current herd average for each individual trait to ensure continued genetic improvement. Sires are selected from the DairyCo list of available bulls which generally lists over 500 UK-available Holstein-Friesian bulls. Using such a tight selection criteria, particularly on milk protein% and the non-productive traits, the list is quickly shortened. The final selection of 3-4 bulls is conducted on dairy, legs/feet and mammary type with individual cows matings allocated according to a corrective mating program.

Table 2: *Average genetic merit of cows in the Future Herd (August 2011).*

Trait	Average
£PLI	£63
PTA Milk kg	-135
PTA Butterfat %	0.14
PTA Protein %	0.08
Sire PTA Fertility	0.3
Sire PTA Lifespan	0.3
Sire PTA SCC	-6.9

To aid the process of sire selection, Greenmount have taken the DairyCo list of available bulls and shortened this to the top 100 ranked on £PLI that are shown by DairyCo to be available in Northern Ireland. Sires in the top 100 currently have a £PLI of 137 or more and have the greatest potential to increase daughter profitability over their lifetime. This list is published by CAFRE on the Rural

Portal website (www.ruralni.gov.uk) following the links to Dairy, Breeding and Genetics and Top 100 sires available in Northern Ireland.

Practical benefits of sire Fertility Index seen at herd level

Since the launch of the Fertility Index in 2005, one of the sire selection criteria in Greenmount's Future Herd has been to select bulls with a positive Fertility Index. However, some sires used before this time carried a negative Fertility Index. This highlights the importance of having and using good information. As discussed earlier, each one point increase in sire Fertility index is expected to increase daughter conception rates by 0.5% points and reduce daughter calving interval by 0.5 days on average. This has been examined at a practical herd level using records from Greenmount's Future Herd from 2004-2011 and records from a few other commercial dairy herds throughout Northern Ireland.

Sire Fertility Index had a statistically significant effect on daughter conception rate and calving intervals in the Greenmount Herd, despite the relatively small number of cows and the degree of variability. When comparing the three sires with the lowest and highest Fertility Index, there was a 21% point difference in daughter conception rate and 21-day difference in average daughter calving interval as shown in Table 3. This equates to a 1.2% point increase in daughter conception rate and a 1.2 day decrease in daughter calving interval per one unit increase in sire Fertility Index.

Table 3: *Comparison of daughter fertility performance in sire of low and high Fertility Index.*

Sire Name	**Sire Fertility Index***	**Average daughter conception rate (%)**	**Average daughter calving interval (days)**
Lowest Fertility Index sires:			
Shaker	-12.2	36.4	395
Bestow	-6.4	33.3	406
Promise	-5.2	25.7	399
Weighted average	**-9.6**	**33.1**	**397**
Highest Fertility Index sires:			
Roxell	+6.7	61.9	361
Jamboree	+8.0	50.0	379
Tugolo	+10.5	56.0	382
Weighted average	**+8.4**	**54.4**	**376**
Difference	**18.0**	**21.4**	**-21.8**
Difference/Unit Fertility Index		**1.2**	**-1.2**

* Sire proofs taken from August 2011 proof run

The results above demonstrate the benefits of positive Fertility Index bulls in just one herd. Similar results have been replicated from calving records in other commercial dairy herds in Northern Ireland where there are 15 or more daughter lactation records per sire. The benefits of a one-point increase in sire Fertility Index all exceed the 0.5 day reduction in calving interval anticipated by DairyCo and ranged from a reduction in calving interval of 0.6 to 1.0 days per unit on the farms of Gary McHenry (Lurgan) and Drew McConnell (Newtownstewart), respectively. A conception rate benefit of 0.7% per unit sire Fertility Index was observed in Gary McHenry's herd when historic service records were analysed.

Results from CAFRE's Fertility Benchmarking have established that infertility currently costs the average dairy herd around £220 per cow per year. This cost is comprised of two components, the first being the extended lactation cost which varies according to yield but is generally around £2-£3

per cow per day. The second cost is the cost of replacing cows culled for infertility. Given the 22-day difference in average daughter calving interval between the two groups of sires used in Greenmount's Future Herd, at an extended lactation cost of just £2 per cow/day, the benefit of using the higher Fertility Index bulls is worth £4,400.

Importance of lifetime performance

Lifespan is one of the traits included in the Profitable Lifetime Index and there is a strong link between this and the lifetime performance of dairy cows. Both lifespan and the lifetime yield of dairy cows are relatively new terms but, nevertheless, they are important in the overall profitability of a dairy herd. Research from the AgriSearch funded fertility study at AFBI Hillsborough established that infertility, lameness and mastitis are the three principal reasons for culling dairy cows, accounting for 27%, 15% and 10% of culls, respectively, with the average cow being culled after completing around 3.5 lactations. All of these are addressed within £PLI.

A recent dataset of milk records from United Dairy Farmers comprising details of over 48,000 culled cows from 680 Northern Ireland dairy herds has been analysed at CAFRE. This has established that the average cow is culled at 6.1 years of age after having completed 3.6 lactations and producing 28,000 litres of milk. However, further analysis has established that there are considerable differences in the lifetime yield of cows at herd level and this has considerable implications for the financial cost of bringing heifer replacements into the herd. Results of this work are shown in Table 4, highlighting the importance that productive life has on lifetime yield.

Table 4: *Comparison of lifetime yield and its effect on the production and replacement costs of Northern Ireland dairy herds.*

	Top 25%	**Second 25%**	**Third 25%**	**Bottom 25%**
Average lifetime yield (litres)	35,279	29,648	24,828	17,806
Average no. lactations	4.2	3.6	3.4	2.7
Age related characteristics:				
Age at first calving (years)	2.4	2.4	2.5	2.6
Longevity (years)	6.7	6.2	5.9	5.3
Productive life (years)	4.3	3.7	3.4	2.6
Production/Fertility:				
Average lactation yield (litres)	8,390	7,909	7,000	6,146
Average calving interval (days)	424	424	421	421
Calvings/cow/year	0.86	0.86	0.87	0.87
Milk sales/cow/year (litres)	7,224	6,802	6,074	5,333
Replacements:				
Replacement rate (%)	23.9	27.4	29.4	36.5
Replacement cost/100 cows (£)*	9,424	12,258	13,738	19,423
Replacement cost (pence/litre)	1.30	1.80	2.26	3.64

*Replacement costs based on cost of replacement heifer of £1,200 and cull cow value of £400.

Summary:

- £PLI is a total merit index that allows bulls to be ranked on a range of productive and non-productive traits.
- Sire Fertility Index is one component of this and has been shown to benefit daughter fertility at herd level.
- A Herd Genetic Report will give details on the genetic merit of your herd and allow you to make more informed decisions on sire selection.
- Through improved lifespan, selection on £PLI should lead to increased lifetime yield.