

Project number: 6390  
Funding source: Teagasc

Date: September 2019  
Project dates: Jan 2013 – Dec 2016

## Using the ‘Next Generation Herd’ to proof the future direction of the national breeding program



### Key external stakeholders:

Irish dairy farmers, ICBF, AI companies, consultancy agencies

### Practical implications for stakeholders:

- The results clearly highlight that the EBI is delivering improved performance and profit generating potential for Irish dairy farmers and cows with a lower carbon footprint.
- Grass intake was similar for both genotypes. Intake capacity was slightly higher for the ELITE cows. There was no difference in production efficiency as indicated by milk solids (Fat + Protein yield) output per unit intake. Gross feed efficiency was slightly lower for the ELITE cows but manifested as a more favourable energy balance. Grazing behaviour observations highlighted a consistent numerical trend towards more intense grazing activity with Elite compared with NA cows, thus supporting the hypothesis that high EBI cows are suited to seasonal pasture-based production.
- The results also demonstrate the power of a suitably constructed index together with a well-considered breeding programme to make considerable favourable change over a relatively short duration.

### Main results:

- ELITE cows produced less milk volume compared to NA (-205kg). They had higher milk composition (+0.28 fat% and +0.18 protein%) culminating in higher MS yield (+8kg). They maintained higher body condition (+0.18), were slightly lighter (-6kg), and had substantially better reproductive efficiency (e.g. 6 week in-calf rate +15 percentage units) and survival to 5<sup>th</sup> lactation (+20 percentage units). Lameness incidence, locomotion score and udder health was similar for both genotypes.
- Dry matter intake was similar for both ELITE and NA. Intake capacity was greatest for the ELITE. However, yield of MS per unit intake was similar for both genotypes. Energy balance was more positive for the ELITE and a consistent numerical trend towards more intense grazing activity was observed with Elite compared with NA cows.
- Economic analyses (base milk price 29.5c/l plus VAT) showed that overall farm profit was considerably more favourable for the ELITE compared to the NA cows (+€296 per cow per lactation across the 3 FT) and ELITE cows produced milk with a 15% lower carbon footprint.

### Opportunity / Benefit:

The EBI is delivering more productive and more fertile genetics. This research highlights the success of the Economic Breeding Index to deliver dairy cow performance consistent with the national breeding objective.

### Collaborating Institutions:

UCD, ICBF

**Teagasc project team:** Prof. Frank Buckley (PI), Dr. Laurence Shalloo, Dr. Brendan Horan, Prof. Pat Dillon, Dr. Sinead McParland, Dr. Keelin O'Driscoll, Dr. Donal O'Brien.

**External collaborators:** Prof. Karina Pierce, University College Dublin, Ms. Kathleen O'Sullivan, University College Cork

### 1. Project background:

Since 2001, in response to observations by Buckley et al. (2000a), Snijders et al. (2001) and Evans et al., (2002), and in consonance with developments in selection indexes globally (Miglior et al., 2005), trait emphasis in dairy cattle breeding in Ireland has shifted from a milk production based index, the Relative Breeding Index, to the profit-based Economic Breeding Index (EBI; Veerkamp et al., 2002) to identify appropriate genetics for Irish grazing systems. Rapid rates of theoretical genetic gain (ICBF, 2018b), and lessons learned from the past, suggest periodic re-evaluation of breeding goals is prudent to validate genetic gain and ensure the compatibility of resultant genetics with the production system. A research herd was established at Teagasc Moorepark in 2013, comprising Holstein-Friesian of high EBI (top 1%; ELITE), and representative of the national average EBI (NATAV). The 'Next Generation Herd' project is a sentinel resource providing a futuristic view of the phenotypic performance of animals selected for extremely high overall genetic merit as indicated by the Irish total merit index, EBI, and to discern the relationship between selection for extremely high EBI and profitability in pasture-based systems of milk production.

### 2. Questions addressed by the project:

- How does the production potential of cows selected based on EBI compare to cows representative of national average?
- Do ELITE cows exhibit improved reproductive efficiency and longevity?
- How do they differ with regard to live weight and body condition score throughout lactation?
- Is there a difference in dry matter intake, production (feed) efficiency and energy balance between the genotypes of cow during lactation?
- Do they differ in their grazing behaviour?
- Are there udder health or lameness differences apparent?
- How do they differ in terms of overall economic efficiency and carbon footprint?
- Is there evidence of Genotype x Environment interaction for any key performance traits?

### 3. The experimental studies:

A four year study evaluating the comparative performance of ELITE and NA Holstein-Friesian dairy cows, under experimental conditions representative of Irish grass-based production circumstances began at Teagasc Moorepark's 'Dairygold' research farm in 2013. The data incorporated 530 lactations (355 ELITE and 175 NA) from 177 ELITE and 95 NA cows. Mean EBI, milk, fertility, calving, beef, maintenance, and health sub-indexes, and standard deviations (in parentheses), of the ELITE and NATAV cows used in the experiment, excluding the influence of own and progeny performance, was €154 (34.2), €28 (20.0), €103 (28.9), €31 (8), - €21 (7.6), €13 (8.5), and €0 (4.6), and €47 (30.9), €7 (17.5), €28 (22.7), €24 (8.6), - €13 (8.0), €2 (8.9), and - €1 (4.6), respectively (ICBF January 2018). Mean calving date was February 15 ( $\pm 16$  d) across the four years. Cows within each genotype were randomly assigned each year post-partum, in mid-March and mid-April, for the early and late calving cows, respectively, to one of 3 experimental feeding treatments. These treatments were put in place to represent a range of seasonal pasture-based production feeding systems ranging from generous to restricted feed supply. The study was conducted as per the project authorization AE19132/P023 of the Health Products and Regulatory Authority (HPRA).

### 4. Main results:

- The NA cows produced the highest milk yield (+205kg). Milk fat (+0.28%) and protein content (+0.18%) was higher for ELITE, and consequently yield of solids corrected milk was similar, while yield of MS (+8kg) tended to be higher for ELITE compared with NA. Milk lactose content did not differ. Production responses to concentrate supplementation or reduced pasture allowance did not differ between genotypes. Milk production profiles illustrated that ELITE cows maintained higher production, but with a slightly lower persistency. Regression of phenotypic performance against PTA illustrate that performance is broadly in line with genetic expectation.
- The NA cows were a little heavier (+13kg) than the ELITE cows. Body condition score was higher for the ELITE cows (+0.14) and this was consistent throughout lactation.
- Reproductive efficiency (pregnancy rate to first service (60% v 46%), six week in-calf rate (73% v 58%) and overall pregnancy rate (93% v 83%) was higher for the ELITE compared to NA. Survival to 5<sup>th</sup> lactation was also superior for ELITE (59%) compared to NA (39%).

- Dry matter intake (DMI) was estimated to be similar for both genotypes. Intake capacity, expressed as total DMI per 100kg of body weight, was greater with Elite (3.22) compared with NA (3.10). Production efficiency expressed as yield of milk solids per 100 kg of BW was greater with Elite (0.32) compared with NA (0.31) although milk solids per unit DMI did not differ between the genotypes. Net energy of lactation (NEL) as a proportion of net energy intake minus net energy for maintenance (NEL/NEI – NEM) and NEI per milk solids kg, indicated a slight reduction in the utilization of ingested energy for milk production with Elite compared to NA. This is, however, recognized as more favourable manifesting as a more positive energy balance with ELITE compared with NA.
- A numerical trend towards more intense grazing activity was observed with ELITE compared with NA cows; numerically longer grazing time (+19 minutes), and number of bites per day (+2,591).
- Preliminary analysis of udder health, as indicated by somatic cell score and incidence of mastitis, indicates while numerically more favourable with the ELITE cows differences were not statistically different compared with NA cows. Neither did the incidence of lameness or locomotion score differ.
- The results illustrate the superiority of the high EBI cows was consistent across diverse pasture-based feeding treatments. That is there was no evidence of Genotype x Environment interaction for any key performance traits within the context of the feeding treatments implemented.
- A simulation to estimate the relative profitability and carbon footprint of both genotypes showed a clear differential in profit (+€296 per cow per lactation) and 15% reduction in carbon footprint per kg of fat plus protein yield in favour of the ELITE cows.

#### 5. Opportunity/Benefit:

- The results clearly substantiate the performance and financial benefits to dairy farmers achievable from maximising herd EBI. High EBI cows are highly productive, have excellent fertility and are efficient converters of grass to milk. They are highly compatible with seasonal calving-based production. The results also highlight the power of a suitably constructed genetic index together with a well-considered breeding programme to make considerable favourable genetic change.

#### 6. Dissemination:

During the life time of this project, one open day was held at Dairygold Research Farm and two at Moorepark. Many mini-open days and discussion group visits were also facilitated. In addition, scientific and popular press articles as well as in-service training to Teagasc Advisory staff all served to deliver the key findings from this research to all relevant stakeholders.

#### Main publications:

O'Sullivan, M., Horan B., Pierce K.M., O'Sullivan K. and Buckley F. (2019). Milk production of Holstein-Friesian cows of divergent economic breeding index evaluated under seasonal pasture-based management. *Journal of Dairy Science* 102 (3): 2560-2577.

O'Sullivan, M., Dillon P., O'Sullivan K., Pierce K.M., Galvin N., Egan M. and Buckley F. (2019). Intake, efficiency, and feeding behavior characteristics of Holstein-Friesian cows of divergent Economic Breeding Index evaluated under contrasting pasture-based feeding treatments. *Journal of Dairy Science* 102 (9): 8234-8246.

O'Sullivan, M., Butler S.T., Pierce K.M., Crowe M., O'Sullivan K., Fitzgerald R. and Buckley F. (2019). Reproductive efficiency and survival of Holstein-Friesian cows of divergent Economic Index, evaluated under seasonal pasture-based management. *Journal of Dairy Science* Under review.

O'Sullivan, M., Shalloo L., Pierce K.M., and Buckley F. (2019). Economic assessment of Holstein-Friesian dairy cows of divergent Economic Breeding Index evaluated under seasonal calving pasture-based management. *Journal of Dairy Science* Under review.

#### Popular publications:

Kennedy, J., "Next Generation Herd Calving Down", 23 February 2013. Irish Farmers Journal.

Kennedy, J., "Fertility in Focus", 5 April 2014. Irish Farmers Journal.

Kennedy, J., "High EBI Delivers", 6 September 2014. Irish Farmers Journal.

Brennan, A., "Next Generation Herd Performing", 28 February 2015. Irish Farmers Journal.

Brennan, A., "Where is the Next Generation?", 26 December 2015. Irish Farmers Journal.

#### 7. Compiled by: Prof Frank Buckley