Environmental research in the Next Generation Herd

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Summary

- The *Next Generation Herd* continues to be a valuable resource to future proof the direction of the national breeding programme.
- The EBI can be used as a tool to reduce greenhouse gas emissions per unit of milk solids output on-farm.
- The methane output of Elite EBI animals may be overestimated using current models.
- Direct selection for lower methane emissions in the EBI may also be possible in the future.

Introduction

The economic breeding index (EBI) was developed in 2001 to deliver genetics that increase profitability in Irish pasture-based dairy systems. The Teagasc *Next Generation Herd* was established to validate genetic gain and ensure compatibility between high EBI genetics and pasture-based systems of milk production. The results from the initial phase of the study demonstrated favourable responses in terms of milk solids yield, intake capacity, fertility and economic performance via selection based on the EBI. New environmental pressures facing the dairy industry, however, also requires milk to be produced in a sustainable manner. In recent years, the *Next Generation Herd* has been used to evaluate the environmental impact of continued selection for the EBI.

Modelled greenhouse gas emissions

Greenhouse gas emissions of both the high (Elite; EBI = €181) and national average (Nat Av; EBI = €82) EBI dairy cows were modelled through a lifecycle assessment analysis using biological data from the *Next Generation Herd*. This analysis was based on a 40-ha dairy farm milking 110 cows and modelled all greenhouse gas emissions (methane, nitrous oxide and carbon dioxide) up to the farm gate. The results are presented in Table 1. The Elite cows produced more milk solids (fat and protein yield) compared with the Nat Av cows. This increase in productivity led to the Elite cows producing more methane per cow. The Elite cows also had superior fertility, however, and therefore had lower emissions from rearing fewer replacement heifers compared with the Nat Av cows, which resulted in no overall difference in greenhouse gas emissions on an area basis between the two groups. The net effect was 11% less greenhouse gas emissions per kg of milk solids. The analysis showed that each €10 increase in EBI between the Nat Av and Elite cows led a 1% reduction in greenhouse gas emissions per kg of milk solids.

Table 1. *Modelled greenhouse gas emissions of the Elite and Nat Av dairy cows*

Item	Elite	Nat Av
Milk solids (kg/cow)	484	434
Greenhouse gas emissions (tonnes/ha)	16.3	16.2
Greenhouse gas emissions per unit milk solids (kg/kg)	12.2	13.7

Direct measurements of methane

Direct measurements of daily methane emissions were also conducted on the Elite (EBI = €233) and Nat Av (EBI = €133) cows in the *Next Generation Herd* using GreenFeed technology between March and October 2021. The results are presented in Table 2. As expected, Elite cows had greater milk solids yield compared with Nat Av cows. The increase in productivity of Elite cows resulted in greater daily methane output when calculated using models similar to that used within the national greenhouse gas inventory. Despite this, there was no difference in the measured methane output between Elite and Nat Av cows. This finding suggests that a proportion of the increased methane output used in national greenhouse gas inventories for elite dairy cows may not exist in practise. The greater milk solids yield and similar daily methane output of Elite cows translated to a dilution of their methane emissions on a unit of output basis, resulting in less methane per unit of milk solids.

Table 2. *Methane emissions of Elite and Nat Av dairy cows*

Trait	Elite	Nat Av
Milk solids (kg)	1.93	1.78
Measured methane (g)	305	301
Calculated methane (g)	370	351
Methane per unit milk solids (g/kg)	158	169

The results also demonstrated there was substantial variation in methane output between individual dairy cows within both Elite and Nat Av groups of cows. This suggests it may be possible to directly select dairy cows for reduced methane emissions in the future. To achieve this objective, the key challenge is to develop technologies capable of generating a large number of methane emission phenotypes, which would allow breeding values for the trait to be calculated. Caution is also required to ensure that other economically important traits such as fertility, feed intake capacity or milk production are not adversely impacted through selection for reduced methane emissions.

Conclusion

The *Next Generation Herd* continues to be a valuable tool for the Irish dairy industry, providing confidence that the EBI is capable of identifying more profitable and sustainable genetics for pasture-based dairy systems in Ireland. The EBI in its current form is selecting for more profitable and environmentally efficient dairy cows.