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Development of a Grass Dry Matter Intake Prediction Model

Key external stakeholders:

Dairy farmers, dairy industry, policymakers

Practical implications for stakeholders:

In order to improve the efficiency by which novel grassland management strategies are evaluated, a mechanism is required to accurately estimate the effects of changes in nutritional factors on animal productivity, by accurately estimating grass dry matter intake (GDMI). Dry matter intake is possibly the single most important factor influencing ruminant production. The prediction of GDMI is also essential in diet evaluation, and the management, of grazing dairy cows at farm level. However, GDMI is difficult for farmers to estimate. Hence the development of a GDMI model is important at both farm and research level.

- Accurate estimation of GDMI enables a greater degree of accuracy in dairy cow nutrition
- Analysis of the relationships between sward variables and animal performance conducted during model development characterises the pasture characteristics affecting productivity
- The development of a GDMI prediction model will provide a means for the efficient evaluation of milk production performance potential of different grass cultivars, grassland management techniques, supplementary feeding strategies, etc.
- The model will be capable of assessing the implications for dairy grazing systems of future component research findings
- Dry matter intake is a key driver of methane emissions by ruminants
    - an accurate assessment of dairy cow intake will enable more accurate prediction of methane emissions
    - a model to predict GDMI will enable prediction of methane emissions from different feeding and management scenarios

Main results:

- The GrazeIn model of GDMI prediction was chosen as a suitable GDMI prediction model for Ireland
- Input variables including cow bodyweight and BCS, grass quality, supplementary feed quality and grazing management are readily available and/or estimable
- Statistical analysis demonstrated that the model, in its current form, is very accurate with a mean prediction error of 0.12 at herd level and 0.16 at individual cow level for GDMI.

Opportunity / Benefit:

These results have implications for dairy farmers, the dairy industry, policy makers and the research community enabling grazing dairy cow GDMI to be accurately estimated.

Collaborating Institutions:

INRA, France
Massey University, New Zealand

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1. Project background:

Dry matter intake is possibly the single most important factor influencing production in ruminants. In the Irish grass-based system this equates to GDMI. Efficient utilization of grazed pasture for milk production is a key element in the competitiveness of the Irish dairy industry. The productivity of grazing systems may be enhanced by improving pasture quality via management, perennial ryegrass cultivar selection, modification of concentrate supplementation, etc. The productivity of a dairy production system is governed by a range of associative and interacting environmental and animal variables. In order to improve the efficiency with which strategies to improve performance are evaluated, a mechanism is required to accurately estimate the effects of changes in nutritional factors on animal productivity, by accurately estimating GDMI. The prediction of GDMI is also essential in the evaluation of the diet and the management of grazing dairy cows at farm level. However, GDMI is difficult to estimate on-farm. Dry matter intake is a key driver of methane production by ruminants. An ability to accurately predict dairy cow GDMI would enable the impact on methane of future nutritional and management strategies to be evaluated. Hence the development of a model to predict GDMI is important at both farm and research level.

2. Questions addressed by the project:

This project had one very clear over-arching goal, which was to develop a model to predict GDMI of grazing dairy cows, utilizing easily available input variables.
An accurate GDMI prediction model will enable the following to be achieved:

- a greater degree of accuracy in the nutrition of the dairy cow within the context of the grazing system
- improved characterisation of the relationships between pasture characteristics and dairy cow performance
- the efficient evaluation of milk production performance potential of
    - different grass cultivars in grass breeding programmes
    - different grazing management techniques
    - different supplementation strategies
- assessment of the implications for dairy grazing systems of future component research findings

3. The experimental studies:

Grass dry matter intake has been estimated using the n-alkane technique at Teagasc Moorepark for the last 24 years. A database was created containing information from grazing studies conducted over the period 1988 to 2009 on the research farms of Teagasc Moorepark. All of these studies measured GDMI. Thus the database contains the GDMI of each cow in each grazing experiment along with other pertinent animal, grass, supplementary feed and environmental variables. This resulted in a database containing 8,787 individual GDMI (and associated) measurements from 1,526 cows in 522 grazing herds from 19 published studies.
A number of existing models which predict DMI were then chosen and evaluated using the data from the database. Such models included the animal biology model for feed intake, production and reproduction from the Australian GrazPlan, the New Zealand model Moosim and the French model GrazeIn. Of these, the French GrazeIn model was chosen as the most suitable. GrazeIn was originally developed as part of the European Grazemore decision support system project. The GrazeIn model combines the main interactions between GDMI regulation, milk synthesis in the udder and the regulation of body reserves. It is based on the INRA Fill Unit system which is utilized in Ireland. The model input variables are categorised into those related to the cow, to the grass, to the grazing management and to the supplement, and all are readily available/estimable by the farmer and researcher alike.

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4. Main results:

- The GrazeIn model of GDMI prediction was chosen as a suitable GDMI prediction model for Ireland
- Input variables including cow bodyweight and BCS, grass quality, supplementary feed quality and grazing management are readily available and/or estimable
- Statistical analysis demonstrated that the model, in its current form, is very accurate with a mean prediction error of 0.12 at herd level and 0.16 at individual cow level for GDMI.
- Further development of this model may include
    - Incorporation of even more readily available input variables, e.g. pre- and post-grazing sward height
    - Incorporation of other scenarios important at farm level, e.g. on-off grazing
    - Development of a user-interface which would facilitate use of the model as a decision-support tool for research/extension purposes

5. Opportunity/Benefit:

Dry matter intake is possibly the single most important factor influencing ruminant production. This means that an understanding of dairy cow DMI, and in the context of Ireland GDMI, is important right across the dairy industry from the research community to policy makers to dairy advisors and dairy farmers alike. The French GrazeIn model was identified as a suitable model for use in Ireland, and its validation as accurate in the context of Irish grazing systems is an important step. The model can be used by dairy advisors and dairy farmers to evaluate the effects of grazing management and nutritional supplementation strategies on dairy cow GDMI and milk production. The model can be used by policy makers and the research community to evaluate the effects of novel grassland management techniques, altered grass chemical composition and supplementation strategies on dairy cow GDMI and milk production. Future work will further improve the accuracy of the model for Ireland.

6. Dissemination:

The primary stakeholders for this research are Irish dairy farmers, research scientists and policy makers. One benefit of this project will be conferred via the use of the GDMI prediction model for directly estimating GDMI. However, the benefits of using this tool extend far greater in terms of its use in aiding to interpret research findings impacts on dairy cow performance.

Main publications:

O'Neill, B.F., Lewis, E., O'Donovan, M., Shalloo, L., Mulligan, F.J. and Delagarde, R. (2011) 'Evaluation of the GrazeIn model of grass dry matter intake and milk production for Irish grass-based production systems.' In: Proceedings of the Agricultural Research Forum, Tullamore, Co. Offaly, 14-15 March 2011, pg.137.

O'Neill, B.F., Lewis, E., O'Donovan, M., Shalloo, L., Boland, T.M., Mulligan, F.J. and Delagarde, R. (2011) 'Investigation of the relationship between bodyweight and grass dry matter intake in Irish dairy cows.' In: Proceedings of the Agricultural Research Forum, Tullamore, Co. Offaly, 14-15 March 2011, pg. 78.

O'Neill, B.F., Lewis, E., O'Donovan, M., Shalloo, L. Galvin, N., Mulligan, F.J., Boland, T.M. and Delagarde, R. (2011) 'The prediction of grass dry matter intake for grazing Irish dairy cows.' In: Proceedings of the Walsh Fellowship Forum, Dublin, 8 November 2011, pg. 56

Popular publications:

7. Compiled by: Dr Eva Lewis and Dr Joe Patton

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