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MultiSward - Multi-species swards and multi scale strategies for multifunctional grassland-based ruminant production systems



Key external stakeholders:

Scientists, grassland farmers, policy makers at national and European level, grass seed industry

Practical implications for stakeholders:

The ambitions of MultiSward are (i) to support developments and innovations to conceive, evaluate and promote new sustainable ruminant production systems using grasslands with a high level of multifunctionality to optimize the provision of environmental goods and biodiversity preservation, as well as economic efficiency and provision of quality food; (ii) to reinforce grassland research in Europe and (iii) contribute to a better understanding of the multifunctional roles of grasslands and livestock systems by European citizens.

- Stakeholders consider grassland to be important for a range of functions and services including milk and meat production, forage production, biodiversity and animal welfare.
- Restricted access to grazing does not affect milk production
- Including white-clover in N fertilised grass swards affects grazing behaviour and rumen function
- Extending the grazing season did not significantly affect nitrate concentration at 1 m depth in the soil
- Cross breeding can offer advantages in terms of fertility and milk production compared to pure breeds
- There is a strong relationship between grass utilisation and cost efficiency.

Main results:

- Irish stakeholders consider grassland to be important for a range of functions and services including bovine milk production, beef and sheep meat production, forage production, animal health and welfare, perception of animal production systems and biodiversity. The least important functions include goat meat production, production of plant fibre, fire control and avalanche control.
- Restricting the access time of cows at pasture had no effect on dairy cow production. Restricted access can therefore be used as a strategy to minimise damage to pasture by poaching during periods of inclement weather conditions
- Turning cows out on 1st of February had numerically but not significantly lower nitrate leached/ha to 1 m in the soil than later turnout. Autumn housing date did not affect the quantity of nitrate leaching.
- Crossing the Holstein-Friesian (HF) with an alternative dairy breed sire such as Jersey or Norwegian Red can increase overall animal performance by increasing herd health, fertility and milk value.

Opportunity / Benefit:

- Increasing the quantity of grazed grass in milk production systems has a positive impact on the sustainability of grass based milk production systems.
- There is a strong relationship between grass utilisation and cost efficiency on Irish dairy farms

Collaborating Institutions:

See page two of the full Technology Update

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1. Project background:

The relative importance of the multiple functions provided to society by grasslands varies depending on regional contexts and grassland type. Farming practices can have both positive and negative externalities. For example, grazing increases energy self-sufficiency at farm level by reducing fossil energy utilisation for harvesting forage and spreading manure but at the same time it may contribute to a higher global warming risk than cutting-based systems due to higher nitrous oxide (N₂O) emissions. Therefore comprehensive studies of the influence of different management strategies on the positive and negative externalities of the production from field to landscape level are required. The potential agronomic benefits from multi-species swards have long been recognized. Grass and legume swards make it possible to reduce energy consumption by replacing nitrogen fertiliser, which is highly energy demanding, by natural nitrogen fixation, whilst maintaining biomass production. Multi-species swards may also allow the extension of the growing season as some species will be more productive at the beginning and end of the traditional grass growing season. This was a large European project. The information provided here under is specific to the research undertaken in Ireland.

2. Questions addressed by the project:

- What are the roles and utility of grassland at catchment and landscape levels from economic, agronomic and environmental perspectives?
- What are stakeholder's requirements and expectations with respect to multi-functionality of grassland?
- Can grass clover swards have a role in intensive dairy production systems in Ireland?
- Are there innovations in grazing and animal management (including animal genetics) that can enhance the sustainability and competitiveness of grassland-based ruminant production system?
- What is the ideal dairy cow breed for grass based milk production systems?
- Identify and analyse the effects of several socio-economic and policy scenarios supporting grassland development in order to support the design of future policies.

3. The experimental studies:

This was a large European study. The experiments and studies undertaken by Teagasc are presented here.

1. Stakeholder survey - The aim of the study was to get an insight into the importance of grasslands for stakeholders in Ireland through a questionnaire.
2. Autumn on/off grazing - The objective of this study was to examine the effect of restricted access to

- pasture in the autumn on the milk production, grazing behaviour and dry matter intake of late lactation spring calving dairy cows.
3. Incorporating white clover into N fertilised grass-clover swards: effects on rumen function and methane emissions
 4. Effect of grazing season length on nitrate leaching to 1 m in the soil
 5. Evaluation of the most appropriate dairy cow breed for grass based milk production systems
 6. Multicriteria evaluation from modelling of innovations (including management strategies) and technologies to increase the overall sustainability and competitiveness of grassland based ruminant production systems
 7. Three socio-economic experimental studies were carried out:
 - a. An analysis of the technical and cost efficiency implications of increasing the proportion of grass in the diet of dairy cows in a range of EU countries, using an econometric approach based on data from the European Commission Farm Accountancy Data Network.
 - b. An analysis of the cost competitiveness of EU dairy farms using accountancy based indicators and partial productivity indicators based on data from the European Commission's Farm Accountancy Data Network.
 - c. Use of Teagasc, National Farm Survey data in econometric methods to examine the factors affecting the adoption of grassland management practices.

4. Main results:

1. 232 valid responses to the stakeholder survey were obtained. Irish stakeholders consider grassland to be important for a range of functions and services including bovine milk production, beef and sheep meat production, forage production, animal health and welfare, perception of animal production systems and biodiversity. The least important functions considered by the stakeholders include goat meat production, production of plant fibre, fire control and avalanche control. All stakeholder groups generally agreed on the importance of the functions evaluated.
2. Restricting the access time of cows at pasture had no effect on dairy cow production. Restricted access can therefore be used as a strategy to minimise damage to pasture by poaching during periods of inclement weather conditions. It can also be used as a strategy to extend the grazing season in spring and autumn on heavier soil types as there were no reductions in animal production when compared to the full time grazing treatment cows even after treatments were applied for a continuous 29-day period. Furthermore, when cows were assigned to a treatment which varied restricted and fulltime access to pasture it was clear that they were able to rapidly adapt as again no differences were observed in production. This has practical implications as it means that when short term inclement conditions are encountered cows will be able to rapidly adapt to restricted access to pasture grazing regimes with no negative effect on production but pasture and soil damage will be minimised.
3. Sward type had an effect on the feeding behavior. Clover presence in swards reduced ruminating time in the summer and autumn. No differences in total VFA were observed but cows grazing grass-clover swards had a greater proportion of rumen VFA isoacids, D-LA and ammonia. Rumen pH was higher for the cows grazing grass-clover compared to those offered grass-only, and this response was greatest in autumn. The grass-clover sward had better quality than the grass only sward in the last three rotations, when sward clover content was greatest. Although cows in late lactation had a tendency to consume more and emitted less methane (CH₄) per unit of feed intake when grazing grass-clover compared to grass-only swards, there was no difference on daily CH₄ emissions or per unit of output as there was no overall increase in milk yield or reduction in absolute CH₄ emission.
4. Paddocks that were only grazed had higher soil water nitrate concentrations to 1 m than those that were grazed and had silage harvested from them. Turning cows out on 1st of February had numerically but not significantly lower nitrate leached/ha to 1 m in the soil than later turnout. Autumn housing date did not affect the quantity of nitrate leached/ha to 1 m in the soil.
5. In Irish grass based systems crossing the Holstein-Friesian (HF) with an alternative dairy breed sire such as Jersey or Norwegian Red can increase overall animal performance by increasing herd health, fertility and milk value.
6. With a fixed land base Jersey crossbred dairy cows can offer improvements to farm profit and moderately mitigate the carbon footprint of milk compared to the HF or purebred Jersey. Losses resulting from reduced cull cow and male calf value are clearly overshadowed by the overall performance of the Jersey×HF. The results suggest that on a per ha basis HF, Jersey and Jersey×HF cows can produce similar yields of milk solids when grazed to similar post-grazing intensities. Norwegian Red crossbred dairy cows can offer improvements in fertility and survival compared to HF and Norwegian Red purebred cows, but had little influence on the carbon footprint

of milk.

7. In terms of the socio economic work conducted it was evident that over the last 15 years there has been only a limited change in the competitive position of the main dairy producing and exporting nations in the EU. On a cash cost basis the grass based dairy system (such as that in Ireland) compares favorably within in the EU. However, due to structural differences in the dairy sector at farm level across the EU there are large differences in the efficiency of grass feed across the EU. For example, whilst the grass based system of production in Ireland was strongly associated with higher levels of cost efficiency, this was not always the case in other EU countries. In terms of grassland management practices, it was consistently the case that farmers that were holders of formal agricultural education were more likely to adopt grassland management practices.

3. Opportunity/Benefit:

- Grazing management can be adapted to optimise the quantity of grazed grass in the diet of the dairy cow. For example, using on off grazing does not reduce milk production but can allow grass to be part of the diet even in wet weather; extending grazing season length does not increase nitrate leaching.
- Selecting the most appropriate animal for grazing systems will maximise output per hectare and ensure that cows are robust and fertile and can have positive economic and environmental impact.
- There is a direct relationship between grass utilisation and cost efficiency on Irish dairy farms

4. Dissemination:

Poster and oral presentations were made at the Agricultural Research Forum, British Grassland Society Research Conference, EGF Conferences and International Society for Applied Ethology Conferences. A number of papers have been published from the project and a number are in preparation.

Main publications:

Main publications:

D. Enriquez-Hidalgo, T. Gilliland, M. O'Donovan, M.H. Deighton, D. Hennessy. (2014) The effect of grass white clover swards on herbage production, herbage dry matter intake, enteric methane emissions and milk production of dairy cows. *Journal of Dairy Science* 97: 1400 – 1412.

Gillespie, P., O'Donoghue, Ca., Hennessy, T., Hynes, S. and Thorne, F. (2015) "Grass utilisation as a driver of efficiency on European dairy farms", contributed paper in the 89th AES Conference, Warwick, UK, 13-15 April 2015.

Kennedy E., Garry B., Ganche E., O'Donovan M., Murphy J.P., and Hennessy D. (2014) Effects of restricting access time to pasture on late lactation dairy cow production . In: Proceedings of the 25th General Meeting of the European Grassland Federation, EGF at 50: The Future of European Grasslands, Aberystwyth, Wales 7-11 September 2014, 19: 737-739.

Popular publications:

Gillespie, P. R., Thorne, F. S., Hennessy, T. C., O'Donoghue, C., & Hynes, S. (2014). Grass use and cost efficiency. *TResearch*, 9 (1), 9.

5. Compiled by: Dr. Deirdre Hennessy