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Grass cultivar structure, digestibility and intake

Key external stakeholders:
Dairy farmers, dairy industry, grass breeders and evaluators, animal nutrition companies and consultants, grass seed sales merchants

Practical implications for stakeholders:
Perennial ryegrass is the most commonly sown grass species in temperate climates, as it has high growth potential and high nutrient value. Research has, however, shown differences in grass utilization and milk production from differing grass cultivars. This project explored differences in sward structure, and digestibility and intake, of differing grass cultivars at different times of the year, in order to try to explain grass utilization and milk production differences. This will aid researchers in interpreting and guiding research, farmers and advisors in choosing grass cultivars, and breeders in breeding future grass cultivars.

Main results:

- Differences in leaf and true stem proportion among grass cultivars were only found during the reproductive phase of the grass plant (May to June), not during the vegetative phase (July to March).
- The cultivar with the highest leaf plus pseudostem proportion correspondingly had the greatest *in vitro* organic matter digestibility.
- A further study, utilising the very accurate *in vivo* method, also found that differences in dry matter digestibility among cultivars were only measurable during the reproductive phase of the grass plant.
- This experiment also revealed that in the early summer period diploid cultivars gave rise to higher intake and dry matter digestibility than tetraploid cultivars, but in the autumn tetraploid cultivars gave rise to higher intake and dry matter digestibility than diploid cultivars.

Opportunity / Benefit:

These results provide data on the structure, and digestibility and intake, of grass as affected by cultivar, ploidy and time of year. This will aid researchers in interpreting research findings regarding grass utilization and grass-based cow milk production performance. Farmers and animal nutrition advisors will benefit by having accurate data on the sward structure, and digestibility and intake, expected from differing grass cultivars. Future research and grass breeding will be improved by the availability of a clear message on the requirements from the grass cultivars of the future.

Collaborating Institutions:

UCD, Ireland
INRA, France
MTT, Finland

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1. Project background:

The optimal use of grazed grass is identified as a key component of profitability in Irish dairy production systems. The importance of utilizing grass in Ireland is reflected in the focus of Food Harvest 2020 on continuing with our grass-based dairy production system. Perennial ryegrass is the most commonly sown grass species in temperate climates, as it has high growth potential and high nutrient value. The Irish grass-based dairy production system is based on cows achieving a high intake, of highly digestible grass. Research has shown differences in grass utilization and milk production from differing grass cultivars. Hence the objective of this project was to measure the effect of different grass cultivars on sward structure, and digestibility and intake, at different times of the year. The outcomes of this project was a unique set of accurate data on sward structure, grass intake and grass digestibility. These data provide information to aid researchers in interpreting and guiding research, farmers and advisors in choosing grass cultivars, and breeders in breeding future grass cultivars.

2. Questions addressed by the project:

- Chart the change in sward structure through an entire season
  - Influence of grass cultivar
- Conduct detailed measurements of intake and digestibility in sheep, measuring the effects of
  - Grass ploidy
  - Grass cultivar
  - Seasonal effect

3. The experimental studies:

The grass plant is comprised of leaf, pseudostem, true stem (including inflorescence) and dead. These components differ in digestibility and variations in their relative proportions can impact sward quality. The objective of the first study was to determine the change in the proportion and organic matter digestibility (OMD) of leaf, pseudostem, true stem and dead components of four perennial ryegrass cultivars (two tetraploids: Astonenergy and Bealey and two diploids: Abermagic and Spelga) throughout a grazing season. The proportions and *in vitro* OMD of leaf, pseudostem, true stem and dead in all cultivars were determined during 10 grazing rotations between May 2011 and March 2012. Each cultivar was represented in one grazing paddock. A subsection of the paddock was identified and divided into four replicates, each measuring 361 m^2. Within each of the four replicates grass samples were taken along a diagonal at eight points. The grass samples were cut to ground level using a scissors and the vertical structure of the sward was preserved using elastic bands. The grass samples were weighed before separation into the upper and lower sward horizon: > 4 cm and < 4 cm (measured from ground level). The upper horizon (> 4 cm) was manually separated into leaf, pseudostem, true stem and dead. The OMD of each fraction of each cultivar at each rotation was determined using the *in vitro* neutral detergent cellulase method of Morgan *et al.* (1989).
The objective of the second study was to determine the effect of four perennial ryegrass cultivars on dry matter intake (DMI) and *in vivo* dry matter digestibility (DMD) in sheep. Twelve Texel wethers were used. The grass cultivars were Astonenergy (tetraploid), Delphin (tetraploid), Tyrella (diploid) and Glenroyal (diploid). The experiment was conducted on two occasions: from 13th May to 7th June 2013 and from 19th August to 13th September 2013. The sheep were housed in individual stalls that allowed for total collection of faeces. Fresh herbage was cut once daily and fed *ad libitum* to the sheep; DMI was recorded daily.

4. Main results:

Experiment 1

- In May and June, Astonenergy had the highest leaf and lowest true stem proportion
- From July onwards there was no difference in leaf or true stem proportion among cultivars
- Bealey had the highest annual mean OMD and Spelga the lowest
  - Bealey had the highest combined leaf and pseudostem proportion, which explains why it had the highest OMD
- OMD followed the order leaf > pseudostem > true stem > dead
- The tetraploid cultivars had a greater leaf and pseudostem proportion, and OMD, than the diploids

Experiment 2

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- There was no difference in sheep DMI among the four cultivars studied
- In May-June there was an effect of cultivar on DMD (Tyrella > Delphin)
    - In August-September there was no DMD difference among the four cultivars studied
- When the effect of ploidy was considered there was a clear seasonal effect
    - In May-June diploid cultivars gave rise to higher intake and dry matter digestibility than tetraploid cultivars
    - In August-September tetraploid cultivars gave rise to higher intake and dry matter digestibility than diploid cultivars

5. Opportunity/Benefit:

These results provide data on the sward structure, and digestibility and intake, of differing grass cultivars at different times of the year to dairy farmers, the dairy industry and animal nutrition companies and consultants enabling them to choose high quality grass cultivars and offer grazed grass as a high quality feed to dairy cows.

6. Dissemination:

The primary stakeholders for this research are Irish dairy farmers, animal nutrition companies and consultants and grass breeders and evaluators. The results of this project have been disseminated through the popular press and at the Teagasc Moorepark Open Days, as well as at scientific conferences and in scientific peer-reviewed publications.

Main publications:

Beecher, M., Hennessy, D., Boland, T.M., McEvoy, M., O'Donovan, M., Lewis, E. 2015. The variation in morphology of perennial ryegrass cultivars throughout the grazing season and effects on organic matter digestibility. Grass and Forage Science 70: 19-29

Beecher, M., Baumont, R., Boland, T., O'Donovan, M., Aufrere, J. and Lewis, E. 2014. Herbage fibre concentrations and digestibility in perennial ryegrass and their relationship with voluntary dry matter intake. In: Proceedings of the joint ISNH/ISRP International Conference, Canberra, Australia, 8-12 September, pg. 373

Garry, B., O'Donovan, M., Boland, T.M. and Lewis, E. 2014. Dry matter intake and *in vivo* digestibility of four perennial ryegrass cultivars. In: Proceedings of the 25th General Meeting of the European Grassland Federation, Aberystwyth, Wales, 7-11 September, pg. 628

Popular publications:

Lewis, E., Beecher, M., Garry, B. and Hennessy, D. 2014. Getting the balance right between grass quantity and quality – what the research says. In: Proceedings of the Irish Grassland Association Conference, 7th January, Kilkennny, p. 4-14

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