Focus Areas - Section 2

Grazing

f2

Forage Grass Breeding

Gillian Young

Breeding ryegrasses today for tomorrow's needs

Key Messages

- The AFBI grass breeding programme is currently breeding varieties for use in 2040 and beyond, with a strong focus on environmental sustainability of grasslands.
- AFBI-bred grass varieties are tailored for the climate of Northern Ireland and are amongst the best available on the market.
- Innovative research is ongoing at the breeding programme to develop novel traits and tools related to nutrient use efficiency and adaptation to climate change.

Background

The AFBI forage grass breeding programme at Loughgall has been breeding ryegrass varieties for local grass-based farming systems in Northern Ireland for over 70 years, producing improved varieties of ryegrass for important target traits, including nutrient use efficiency, quality and resistance to disease.

Research studies

Grass breeding is a slow and expensive process, taking up to 15 years to complete. As a result, AFBI's forage grass breeding researchers continually seek to breed for the future, anticipating the requirements of industry decades ahead, a task that is more important than ever as climate mitigation measures become ever more needed. Primary objectives of the programme have included selection for improved yield, persistence, resistance to diseases and nutritional quality. However, increasing effort is now being directed at breeding for nutrient use efficiency and adaptation to climate change, particularly drought. Collaborative projects are ongoing in this remit: for example, novel research has begun to identify novel traits for improved nitrogen use efficiency as part of a partnership with University College Dublin, Munster Technological University and Teagasc within the DAERA/DAFM funded project BIOS4Grass.

Figure 1: Grass breeding trials at AFBI

Research findings

New varieties at a late stage of development have been shown to provide consistent improvements for target traits that can improve productivity and raise outputs. Research studies have revealed annual yield improvements in recommended varieties of 0.52% under silage management and 0.35% under grazing, demonstrating the continual improvement of new forage grass varieties year on year. Improvements in quality of forage also leads to increased metabolizable energy content, improving conversion of energy into animal product and lowering nitrous oxide emissions by reducing N excretion in the urine. Modelling research indicates that diets of higher digestibility can reduce methane output per energy-corrected milk yield, thereby helping to reduce emissions of greenhouse-gases from livestock systems.

The success of the AFBI forage grass-breeding programme is clear. Since 1998, 20 improved forage grass varieties have entered forage grass variety recommended lists around the UK and Ireland, at a rate of 1.6 per year. Each of these varieties have been tested against its peers by national testing authorities across the UK and Ireland, only gaining a place on a recommended list once proven to be equal or better to other varieties on the list. Twenty AFBI-bred varieties are included on the current Recommended Grass and Clover Lists for England and Wales (RGCL) and nine are recommended for use in ROI.

Potential Impact for Farming for the Future

AFBI's forage grass breeding programme aims to support local farmers of the future by conducting research into the development of new locally adapted grass varieties for key traits of the future, including improved nutrient use efficiency, persistency and resilience to climate change by targeting new environmentally positive traits whilst continuing to produce higher yielding varieties of higher digestibility that can improve profitability whilst reducing methane release from the rumen of animals.

The AFBI grass breeding programme is co-funded by DAERA and commercial partner Barenbrug.

Table 1: Key AFBI-bred varieties commercially available in seed mixtures in Northern Ireland

VARIETY	PLOIDY	MATURITY	HEADING DATE	KEY CHARACTERISTICS
Moyola	Diploid	Early	14th May	High early grazing and spring yields; excellent resistance to mildew
Glasker	Diploid	Early	18-May	Excellent first cut yield and spring yields
Bannfoot	Tetraploid	Hybrid	20-May	Perennial-type; excellent persistence with yield advantage of hybrid
Fintona	Tetraploid	Intermediate	20-May	Unrivalled spring grazing yields; excellent ground cover
Strangford	Diploid	Intermediate	21st May	Early and late season growth provides excellent forage at either end of the growing season
Seagoe	Tetraploid	Intermediate	22-May	High silage yield; excellent crown rust resistance
Galgorm	Diploid	Intermediate	22-May	Highest yielding intermediate diploid under grazing
Tollymore	Tetraploid	Intermediate	23-May	Highest ME yield of the intermediate tetraploids under grazing
Moira	Diploid	Intermediate	24-May	Early spring grazing yield; Excellent disease resistance
Gosford	Diploid	Intermediate	29-May	Multi-purpose high quality variety; high crown rust resistance
Caledon	Tetraploid	Intermediate	29-May	High early grazing yield; high quality silage yield; excellent crown rust resistance
Ballintoy	Tetraploid	Late	31-May	Excellent early grazing yield; consistent growth pattern throughout growing season
Gracehill	Tetraploid	Late	01-Jun	Excellent all-round performer right across the growing season
Dundrod	Diploid	Late	01-Jun	Very high conservation yields, particularly at 1st cut
Callan	Diploid	Late	02-Jun	High spring growth, comparable with earlier varieties; best suited to grazing
Glenarm	Diploid	Late	02-Jun	Excellent first cut yield; good all-arounder but best suited to silage
Ballyvoy	Diploid	Late	02-Jun	High spring growth, comparable with earlier heading varieties; excellent silage variety
Killylea	Tetraploid	Late	03-Jun	High yields and digestibility; excellent shoulder growth

Plant variety testing in AFBI

Ciaran MacManus, Paul Cottney, Adam Gauley and Lisa Black

Climate proof crops

Figure 1. Variety plots of Hybrid Italian Ryegrass being cut to determine yield and quality data for Northern Ireland and the UK

Key Messages

- AFBI have a statutory role to test plant varieties for the industry and provide real-time evaluation of new varieties in current climatic conditions.
- In the last 30 years, variety testing has contributed to an average four t/ha increase in silage yield, equal to a 30% rise in total yield.
- Since 1980, variety testing has contributed to an average 2 t/ha increase in Spring Barley yield, equal to a 45% rise in total yield.
- Variety testing ensures that new, fit-for-purpose germplasm is reaching market every year.
- International research, led by AFBI Crossnacreevy, is driving innovations in plant variety testing.

Background

Plant variety testing is a statutory function performed by organisations like AFBI across Europe and beyond, which enables plant breeders to submit new cultivars for testing to determine if they are novel and whether they perform better than existing varieties.

These decisions are made following 2 different types of variety testing, DUS and VCU.

1. DUS testing ensures that new candidate varieties are Distinct from all other varieties, Uniform within the population and Stable across generations. Once this is established, Plant Breeders' Rights are awarded to the new variety which can then be marketed provided it passes performance testing. AFBI conducts DUS testing for herbage species on behalf of the Animal and Plant Health Authority (APHA) for the UK. Multiple traits, morphological and

physiological, are measured over a 3-year period to determine DUS for a range of herbage species and white clover in AFBI for the UK seed market.

2. VCU ensures that candidate varieties provide Value for Cultivation and Use. Agronomic performance of new varieties must exceed that of existing varieties. AFBI Crossnacreevy conducts VCU testing for multiple species including grass, clover, and cereals. The data generated from VCU trials contributes to the UK National List and Recommended List trialing systems database and resulting recommendation publications.

Research studies.

AFBI Crossnacreevy is at the forefront of innovation in plant variety testing. As coordinators of the EC Project InnoVar, AFBI is focused on improving efficiency of testing systems and introducing traits of sustainability and resilience to plant variety testing. New technologies such as using drones to efficiently capture data from field trials and genetic testing to identify varieties with good disease resistance have shown that innovations can improve efficiency of testing systems and add value too. Work is also ongoing to develop a new categorisation system that prioritises variety ability to grow under a range of biotic and abiotic stresses, including high disease pressure, drought and variable, extreme weather.

Research findings

Genomics, phenomics and machine learning are offering realistic opportunities to drive efficiencies in plant variety testing. The InnoVar project demonstrates the feasibility of harmonized performance testing across wide-geographic areas (Europe).

Impact

Plant variety testing ensures that the best genetic material is available to farmers, providing real-time data on crop performance as climate changes. AFBI specialises in grass, clover and cereal variety testing and is leading international research to drive efficiencies in plant testing systems and to ensure that future varieties are evaluated for sustainability and resilience. This work is critical to shaping breeding programs to target varieties for future farming challenges.

This project was funded by DAERA and Horizon 2020.

Figure 2. The HPLR – High performance low risk – categorisation system for plant varieties offers the opportunity to describe any crop in terms of sustainability and resilience. InnoVar has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818144.

GrassCheck

Taro Takahashi, Naomi Rutherford & David Patterson

Latest discoveries and future outlook

Figure 1. GrassCheck simulated grazing plots at AFBI Hillsborough

Key Messages

- The 'GrassCheck' initiative has been providing farmers with a 2 week forecast of grass growth for 25 years. It has proven to be a very useful tool, especially to proactively manage grass swards during periods of volatile weather.
- The GrassCheck initiative continuously tracks the impacts of weather and soil conditions on grass growth and grass quality and is continuously being improved.
- An accompanying computer simulation model facilitates growth forecasting, informing NI farmers as well as AFBI's grassland resilience research.

Background

Having launched in 1999, GrassCheck is celebrating its 25th anniversary this year. This is a globally unique long-term monitoring programme designed to track the impacts of weather and soil conditions on grass growth and grass quality. Our core data are generated from four sets of experimental plots located at AFBI, Hillsborough and CAFRE, Greenmount, both under simulated grazing management (Figure 1).

Since 2017, with the support of AgriSearch, grass growth and grass quality records have also been collected from the GrassCheck Farm Network. The network comprises ~50 dairy, beef and sheep enterprises located across the province, to represent a diverse range of geographical conditions as well as grazing management strategies adopted on the farm.

In 2019, we further partnered with the Centre for Innovation Excellence in Livestock (CIEL) and Rothamsted Research to run a sister programme - GrassCheckGB, with the view to accumulate data under warmer conditions to prepare ourselves for the managing swards under future weather patterns.

Research studies

Through weekly bulletins published in the press and online, GrassCheck provides NI farmers with current grass growth rates and grass quality information, along with 7-day and 14-day grass growth forecasts derived using AFBI's proprietary GrazeGro computer simulation model, to support on-farm decision making. The data generated during this process are then reanalysed to further improve the forecasting accuracy and to inform AFBI's wider effort to enhance profitability, sustainability and resilience of grassland agriculture. As an example, we are currently investigating the exact mechanism wherein the prolonged droughts in 2022 and 2023 affected the grass physiology and how we can best prepare for similar shocks in the future.

Research findings

Across the GrassCheck Farm Network, the average dry matter production in 2023 was 12.0 t/ha for dairy farms and 11.1 t/ha for beef & sheep farms, with a farm-level maximum of 15.7 t/ha. The average grass utilisation (above 1500 kg DM/ha) was 81.0%, although this value tended to be slightly lower amongst high yielding farms. The growth rate predictions given by GrazeGro were associated with an average error (root mean square error) of 12.2 kg DM/ha/day, a level of inaccuracy considered to be largely harmless for practical decision making. The model, however, predicted the adverse impact of the summer drought prematurely by 1-2 weeks (Figure 2); we are therefore currently working to improve the soil moisture component of the model to better represent the resilience of contemporary swards.

Potential impact for Farming for the Future

In addition to supporting NI farmers' immediate decision making on farms, GrassCheck data and GrazeGro model also contribute to AFBI's climate adaptation research. Examples of such work can be found elsewhere within the booklet ("Building production efficiency and climate resilience into grassland farming").

This work is funded by DAERA and AgriSearch

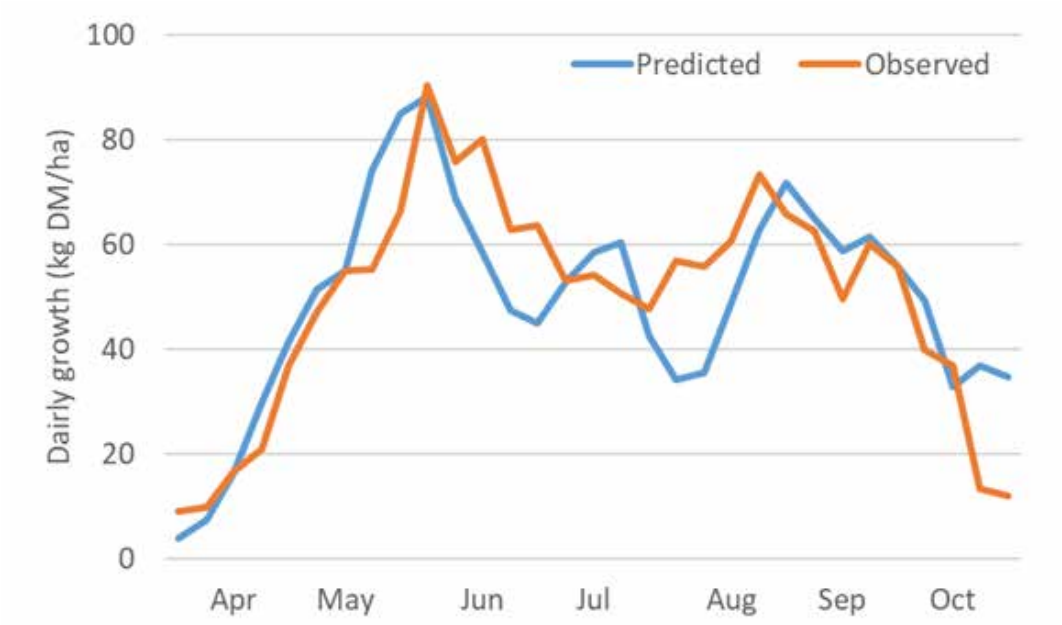


Figure 2. Performance of AFBI GrazeGro forage growth simulation model during the 2023 season

Dairy Heifer Rearing

Gillian Scoley

Rotational grazing systems for dairy heifers can lead to reduced carbon footprint and improved sward performance

Fig 1. Rotationally grazed heifers

Key Messages

- Rotational grazing of dairy youngstock offers improved live weight gain compared with set stocking
- Rotational systems offer the opportunity to ensile more forage for winter feeding

Background

Achieving target weight for age, in a cost-effective manner, is a key objective to reducing the non-productive period in replacement dairy heifers. Failure to do so not only increases rearing costs, but has also been shown to impact negatively on future milk production, fertility and the carbon footprint of the dairy enterprise.

Recently, French researchers have shown that a delayed age at 1st calving to 36 months compared to 24 months increased total methane emissions, (the main greenhouse gas produced from cattle) to the point of calving by 71% and the overall methane emissions per litre of milk for the whole dairy enterprise by 12-16%.

Grazed grass, when utilised efficiently, is a low-cost, high-quality feedstuff on any dairy farm and should be maximised in the diet of growing heifers. However optimum utilisation requires animals to be grazing at the right time, to the right height, and having the right number of livestock per area. Furthermore, changeable weather and grazing conditions, as well as differing grazing management strategies, can result in highly variable animal and sward performance.

Table 1 (over page) highlights the value of grazed grass compared to grass silage and the impact of a range of utilisation rates on the feed costs within heifer rearing systems.

Table 1. Feed costs of grass silage and grass at different utilisation rates in heifer rearing systems

FEED TYPE	FULL ECONOMIC COST (£/T DM)	COST (P/MJ ME)
2-cut grass silage	137	1.31
3-cut grass silage	155	1.36
Grazed grass		
70% utilised	88	0.76
80% utilised	79	0.68
90% utilised	72	0.62

Research Studies

A study was conducted to investigate the animal and sward performance of rotational versus set stocked grazing systems with modern day dairy herd replacements. The study commenced mid-June and ran for 113 grazing days, ending on 10th October. Within the study, 90 Holstein heifers aged 3-7 months with an average live weight of 177 kg were assigned to one of three grazing systems:

1. set stocked grazing system
2. 6-day rotational system in which animals were rotated through 6 paddocks every 6 days
3. 3-day rotational system, with animals rotated through 12 different paddocks every 3 days.

Target pre and post grazing sward heights were set at approximately 2500 and 1600kg DM/ha, respectively and all areas received the same fertilizer treatment throughout the study. Surplus grass was removed as silage when possible.

Research Findings

Surplus grass was ensiled from the paddocks, with a total of 1355, 812 and 392 kg DM/ha removed from the 3-day, 6- day and set stocked system respectively. With 2-3.5 times more grass ensiled with the rotational systems this would equate to up to 14 days extra winter feeding for each hectare compared to the set stock system.

Heifers which were on the 3- and 6-day rotational grazing systems had a daily live weight gain of 0.76 and 0.78 kg/d respectively with the set stocked group growing at only 0.73 kg/d (up until 20 September). This 7% reduction in growth performance if unchecked and repeated in the second grazing season could result in a failure to meet weight targets and/or possible delayed age at calving.

Potential Impact for future farming

Rotational grazing systems using the same quantity of land for dairy calves enabled up to 1.36t DM/ha or almost 3.5 times more to be ensiled from the paddocks compared with set stocking, whilst also delivering up to a 7% improvement in heifer growth rate. This has a positive impact for cost of production and means heifers are in a good position to meet key performance milestones, such as calving at 24 months of age.

This project was funded by DAERA.

Performance of dairy cows when offered alternative grazing species

Lauren Chesney, Conor Holohan, David Patterson

Effect of ribwort plantain (*Plantago lanceolata* L.) inclusion in grazing swards on the performance of high-yielding dairy cows

Key Messages

- Inclusion of plantain did not impact milk production, body condition score (BCS) or liveweight
- Inclusion of plantain reduced milk fat but not milk solids output
- Inclusion of plantain reduced milk urea
- Inclusion of plantain altered sward quality

Background

In the pursuit of future proofing dairy production systems there is growing interest in forages that not only enhance animal performance, but also contribute to mitigating environmental impacts. Incorporating ribwort plantain (*Plantago lanceolata* L.) into the dairy cow diet has potential to reduce nitrogen losses, and nitrous oxide and methane emissions. However, little is known about the trade-off between these environmental benefits and milk production in European pastoral systems. This study investigated the impact of varying levels of dietary plantain on performance of grazing dairy cows.

Research studies

Sixty-eight spring-calving Holstein-Friesian cows were assigned to one of three grazing treatments. Treatments comprised: perennial ryegrass (*Lolium perenne* L.)-only (GO); low sward plantain (LP, 27% plantain); and high sward plantain (HP, 43% plantain). Cows were rotationally grazed from April to October 2023 at a stocking rate of 3.9 cows ha. Average daily concentrate supplementation was 7.1 kg DM/ cow. Pre-grazing herbage mass was 3870, 3990, and 4097 kg dry matter (DM) per ha for GO, LP, and HP respectively, while post-grazing herbage mass was 1772, 1963, 1807 kg DM per ha for GO, LP, and HP respectively. Fertiliser applications were similar across all treatments. Milk yield and composition, body condition score (BCS), liveweight, herbage yield and herbage quality were all monitored.

Research findings

Results show that daily milk production did not differ significantly between treatments. Milk protein and lactose were also similar however milk fat was lower in Low Plantain (LP) swards compared with the perennial ryegrass swards (GO). Milk solids output was however similar between treatments (Table 1). Milk urea was highest for perennial ryegrass (GO) swards and lowest in high plantain (HP) swards. Milk urea N has been proposed as an indicator of dietary N surplus and excretion. Therefore, grazing swards with plantain results in lower levels of surplus nitrogen which should reduce the potential of the resultant manure/urine to produce ammonia and N2O. Sward type had no effect on body condition score or body weight. In terms of herbage production, GO and LP were similar (13.0 and 12.7 t DM per ha respectively) while HP was higher than both with 14.2 t DM per ha.

Forage fibre content (NDF) and dry matter (DM) were highest in GO and lowest in HP, while crude protein (CP) was similar between treatments (Table 2). Sward digestibility (DOMD) was highest in GO and lowest in HP, which may reflect the presence of stem and seed heads in the plantain swards observed during the summer months.

Table 1. Effect of sward type on dairy cow performance

	GRASS-ONLY	LOW PLANTAIN	HIGH PLANTAIN	SIGNIFICANCE
Milk yield (kg cow^{-1} day^{-1})	30	30	28	no
Milk fat (g kg^{-1})	45^{b}	43^{a}	44^{ab}	yes
Milk protein (g kg^{-1})	34	33	33	no
Milk solids (kg cow^{-1} day^{-1})	2.4	2.3	2.2	no
Milk lactose (g kg^{-1})	46	46	46	no
Milk urea (mg l^{-1})	299^{c}	277^{b}	258^{a}	yes
Body condition score	248	249	244	no
Body weight (kg)	580	563	559	no

Means with different superscript letters are significantly different from each other.

Table 2. Chemical composition (g kg-1 DM) of herbage offered

	GRASS-ONLY	LOW PLANTAIN	HIGH PLANTAIN	SIGNIFICANCE
NDF	438^{c}	404^{b}	366^{a}	yes
ADF	256	255	249	no
CP	171	168	168	no
Ash	96^{a}	102^{b}	111^{c}	yes
DM (%)	18^{c}	16^{b}	14^{a}	yes
DOMD (%)	75^{b}	73^{ab}	72^{a}	yes
WSC	164^{b}	144^{ab}	140^{a}	yes

Means with different superscript letters are significantly different from each other.

Potential Impact for Farming for the Future

Results indicate that the inclusion of ribwort plantain, at the levels studied, reduces milk urea and milk fat content but does not negatively impact milk output. Further examination of cow performance at higher dietary plantain inclusion levels is warranted.

This project is funded through DAERA Evidence and Innovation.

Macro and micronutrient content of grass

Francis Lively

Grazed grass alone may be insufficient to supply the macro and micronutrient requirements of livestock during the grazing season

Key Messages

- An evaluation of the macro and micronutrient content of grass indicated that levels vary throughout the season, with the highest levels normally observed in autumn grass
- Whilst the level of many nutrients was adequate for livestock health and performance, copper and zinc were often below optimal and supplementation would be required.

Background

Macro and micronutrient deficiencies in livestock can have a detrimental impact on animal health and performance. Grass quality is often determined by dry matter, crude protein, metabolizable energy, fibre and water-soluble carbohydrate concentrations and has been regularly monitored throughout the growing season for the last 25 years in Northern Ireland (NI) as part of Grass Check NI and for the past 3 years as part of Grass Check GB (England, Scotland and Wales); however, there remains very limited information on the macro or micronutrient content of grass.

Research Studies

Farmers from the GrassCheck NI and GB network were invited to submit fresh grass samples at fortnightly intervals from their grazing paddocks during the 2021 - 2023 grazing season. Samples were taken by cutting herbage to soil level in the paddock that livestock were about to enter, as to be representative of the grass that the livestock would be consuming. Samples were analysed for nitrogen (N), phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg), boron (B), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), zinc (Zn), cobalt (Co), selenium (Se) and sodium (Na).

Research Findings

Overall, 40 farms (12 dairy and 28 beef and/or sheep) supplied a total of 640 samples. Grass from dairy farms had significantly higher levels of N, P, K, Co, Se, Na than grass from beef and/or sheep farms; whilst grass from beef and/or sheep farms had significantly higher levels of Ca, B, Mn, Zn than grass from dairy farms (Table 1). During the grazing season the concentration levels of the majority of macro and micro-nutrients varied, indicating seasonal differences, normally with highest levels recorded in autumn grass. Threshold values for minimum livestock requirements are presented in Table 1. Grass was lower than requirements for Ca (dairy), Mg (dairy), Zn (beef, sheep and dairy) and Cu (beef and dairy) for livestock production; indicating that supplementation would be required to ensure optimal animal health and performance could be achieved.

Potential Impact for future farming

The collection and analysis of this data has identified that the macro and micronutrient content of grass is not stable and can vary throughout the season and across farm types. Frequent analysis of grass samples should be considered at a farm level to ensure grazing animals are getting supplied their requirements to ensure optimal health and performance. To prevent deficiency, supplementation (for example, mineral licks, bolus, drench etc) should also be considered.

Table 1. The macro and micronutrient concentration of grass samples analysed by farm type and season; and the minimum critical requirements for livestock

	FARM TYPE			SEASON[1]				MINIMUM CRITICAL REQUIREMENTS FOR LIVESTOCK[2]		
ELEMENT	BEEF & SHEEP	DAIRY	DIFFER-ENCE	MARCH TO MAY	JUNE TO AUG	SEPT-AUG	DIFFER-ENCE	SHEEP	BEEF	DAIRY
Nitrogen (g/kg)	29.1	31.7	Yes	29.4^{a}	28.3^{a}	33.5^{b}	Yes	4.4	19.0	19.2
Phosphorous (g/kg)	3.1	3.3	Yes	3.1^{a}	3.1^{a}	3.5^{b}	Yes	1.9-3.5	1.9-3.5	3.0-4.4
Potassium (g/kg)	15.4	16.6	Yes	13.9^{a}	15.9^{b}	18.3^{c}	Yes	5.0-8.0	6.5	9.0
Calcium (g/kg)	6.6	5.5	Yes	5.6^{a}	6.3^{b}	6.2^{b}	Yes	2.0-3.9	5.8	6.0
Magnesium (g/kg)	1.8	1.8	No	1.5^{a}	1.8^{a}	2.2 ^{a}	Yes	1.2-1.8	1.6	2.1
Boron (mg/kg)	6.81	5.55	Yes	5.61^{a}	7.11^{b}	5.82^{a}	Yes	-	-	-
Copper (mg/kg)	8.12	8.03	No	7.50^{a}	7.62^{a}	9.23^{b}	Yes	4	10	10
Iron (mg/kg)	183.4	159.5	No	184.6^{b}	159.0^{a}	170.6^{ab}	Yes	30-50	50	50
Manganese (mg/kg)	111.8	70.9	Yes	95.1	89.9	89.1	No	20-40	40	40
Molybdenum (mg/kg)	1.45	1.07	No	1.38	1.18	1.21	No	0.025	0.025	0.025
Zinc (mg/kg)	14.8	12.5	Yes	12.7	13.5	14.7	No	20-33	40	40
Cobalt (mg/kg)	0.77	0.87	Yes	0.21^{a}	1.12^{b}	1.14^{b}	Yes	0.1-0.2	0.1	0.1
Selenium (mg/kg)	1.49	1.83	Yes	1.55^{a}	1.45^{a}	1.97^{b}	Yes	0.03	0.05	0.3
Sodium (g/kg)	1.6	1.8	Yes	1.3^{a}	1.7^{a}	2.1^{b}	Yes	1.0	1.8	1.0

[1] Means of each parameter with different superscript letters are significantly different from each other

[2]Adapted from Whitehead, 2000

Sward diversity: the impact on youngstock health and performance

David Patterson, Naomi Rutherford, Denise Lowe, Aurelie Aubry & Francis Lively

Multispecies swards for dairy-origin beef production systems

Key Messages

- Sward diversity is key in improving sward resilience, soil health and biodiversity
- Calves achieved on average a 17% greater DLWG when grazing a multispecies sward compared with a grass clover sward
- Calves grazing multispecies swards had consistently lower faecal egg counts over the grazing season
- Care needs to be taken to reduce the risk of bloat when grazing swards with a high clover content

Background

There is growing interest in the need to increase plant diversity in swards. The suggested benefits from incorporating a mix of grass, legume and herb species into grazing platforms include improved drought tolerance, soil health, biodiversity and carbon sequestration. Their reduced nitrogen fertiliser requirement results in environmental benefits through reduced leaching and nitrous oxide emissions and economic benefits such as reducing production costs and susceptibility to fluctuations in fertiliser prices. This study investigated the impact of sward diversity on the health and performance of dairy-origin beef calves.

Research studies

A grazing trial was conducted in the summers of 2020 and 2021, involving 48 dairy-origin beef steers in each year of an average age of 6 months and live weight of 200kg. Calves were grazed on either multispecies swards (MSS) or grass clover swards (GCS). The MSS consisted of 4 species (with percentage of the mixture in brackets); perennial ryegrass (57%), plantain (15%), chicory

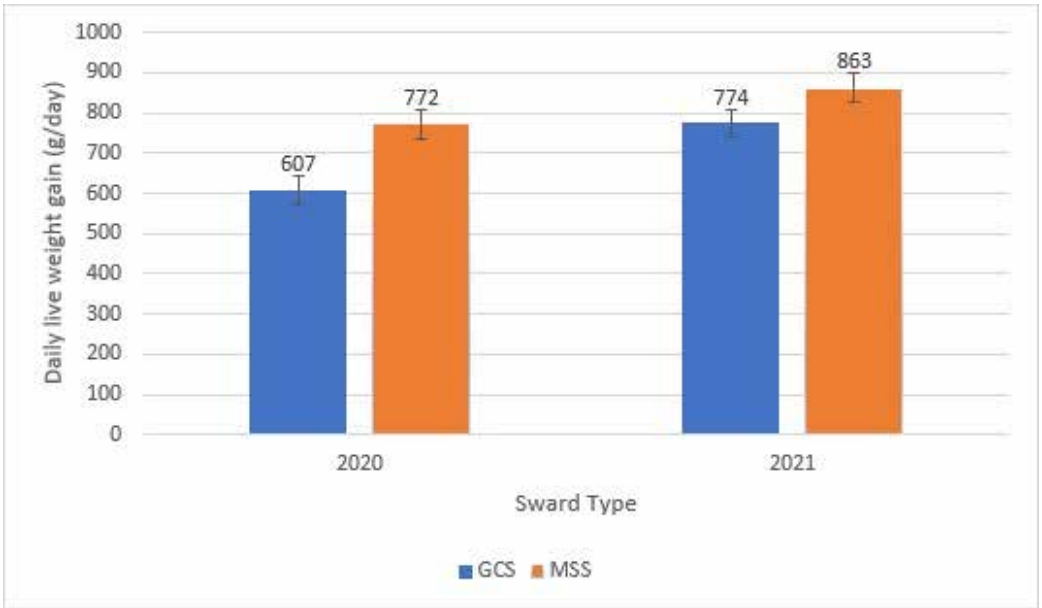


Figure 1: Live weight gain of dairy origin calves grazing either grass clover sward (GCS) or multi species swards (MSS) during 2020 and 2021

(10%) and white clover (18%), while the GCS consisted of perennial ryegrass (87.5%) and white clover (12.5%). Both swards received 75 kg N/ha in spring and calves were rotationally grazed. Calf liveweight, faecal egg count (FEC) and trace element status (year 2 only) were monitored.

Research findings

Results show that MSS swards have the potential to enhance animal performance. In this study the calves grazing MSS had a 17% greater DLWG than those grazing grass clover in both 2020 and 2021 (Figure 1). FEC was consistently lower throughout the grazing season for calves grazing MSS compared with those grazing GCS. This demonstrates that this MSS mixture had the potential to reduce anthelmintic requirements, likely due to the condensed tannin content of the herb species in the sward. Therefore, MSS containing herbs could play an important role in minimising the development of anthelmintic resistance on farm. Monitoring of the calves' trace element status showed no difference between sward types, although it should be noted that neither group of calves were deficient in trace elements. These results were all achieved with a 38% lower N fertiliser application rate than what would be required for conventional perennial ryegrass swards receiving the average fertiliser rate for NI beef and sheep farms of 120kgN/ha. This equates to a saving of £550 across a 10ha grazing platform and a reduction in emissions of 9.8 tCO_2e.

One of the carbon footprint challenges with the inclusion of clover in swards is the high risk of bloat, which occurred in four calves in year one and one calf in year two of this study. All bloat cases were treated, and mortality was zero. However, even with measures being taken in year two to reduce this incidence, the lush early autumn sward still posed a risk. This highlights the need for additional research on the matter and the need for a holistic assessment of grazing systems.

Potential Impact for Farming for the Future

Multispecies swards containing grasses, legumes and herbs have the potential to improve animal productivity and also to reduce reliance on anthelmintics as a parasite control mechanism, which is likely due to the tannin content of the herbs. The clover component of the MSS is the main driver of lower fertiliser usage, leading to reduced N_2O emissions and nitrate leaching.

This project was jointly funded by Horizon 2020 (EU) and AgriSearch NI.

Hills and Uplands for Beef and Sheep

Denise Lowe

Huge potential for providing ecosystems services

Key messages

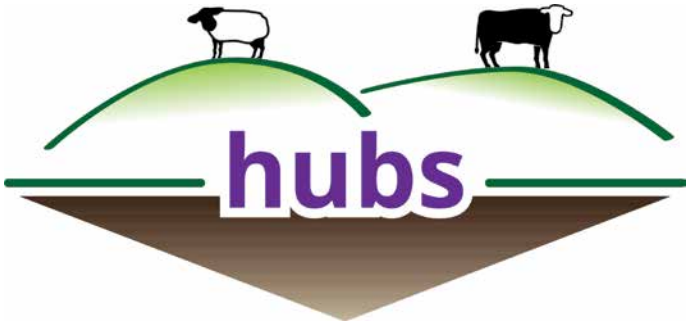
- Hills and uplands are a major part of Northern Ireland land mass and are dominated by beef and sheep farming.
- In addition to food production, these areas have huge potential for improved air and water quality, soil health, carbon footprint and biodiversity if properly managed.
- Further research is urgently needed to address the interaction of different factors (grazing, nutrient fertilisation, fire, re-wetting) in influencing carbon (C) and nitrogen (N) dynamics in soils and vegetation.

Background

The hills and uplands of Northern Ireland represent a major land mass in the Northern Irish agricultural industry, with Severely Disadvantaged Areas (SDAs) extending to 487,000 hectares or 47% of all farmed land in Northern Ireland. These areas are dominated by beef and sheep farming and have huge potential for improved air and water quality, soil health, carbon footprint and biodiversity if properly managed, in addition to producing valuable food.

Research studies

This project entitled 'Hills and Uplands for Beef and Sheep' (HUBS), was undertaken to collate existing knowledge and identify knowledge gaps to develop a strategic long-term programme of research. The aim of this initial scoping study, which engaged extensively with stakeholders invested in the uplands and hills, was to identify the key challenges in driving sustainability in these areas and to understand the synergies and trade-offs that exist between production and other ecosystems services.



Research findings

It is well established from previous research that cattle are less selective grazers than sheep, but cattle have been shown to be beneficial in terms of controlling invasive hill species such as purple moor grass (*Molinia caerulea*). However, the role of cattle grazing (and mixed grazing) in affecting soil carbon sequestration (and soil greenhouse gas emissions), soil erosion, vegetation structure and diversity is poorly understood, with no clear guidelines on how to best utilise cattle in a hill and upland environment in a positive way to restore and regenerate landscapes.

Other research priorities identified included the need for further research on the role of re-wetting (i.e. blocking drains) to ameliorate peatland biogeochemistry (i.e. reduce C losses and increase C gains), which in turn can enhance water quality and improve biodiversity. Other key areas identified for future research were on the effects of controlled burning on biodiversity within the uplands and the role it plays in mitigating uncontrolled wildfires and additionally the role of alternative planting strategies including trees and species-diverse grasslands, targeted spatial plantings and drainage measures to mitigate flooding.

Potential Impact for Farming for the Future

The effects of upland farming management on soil carbon and nitrogen dynamics and water quality can be highly variable and depend on how common management practices (e.g. grazing, burning) and key environmental factors (e.g. soil fertility, vegetation structure and composition) interact to affect ecosystem functioning.

There is, however, evidence from literature that reduced grazing pressure and fertilizer N input, re-wetting of drained peatland areas, appropriate fire management, diversification of the landscape either by introducing plant species mixes (grass-herb-legume mixes) or adopting strategic planting may ameliorate soil health, reduce GHG emissions and increase environmental sustainability of hill and upland farming in Northern Ireland. This review highlighted several knowledge gaps, and the need for tailored management in the hills and uplands to optimise their environmental potential. Thus, a comprehensive research program is required to gain a better understanding of the long-term grazing strategies suitable for this dynamic environment.

This project was funded by DAERA.

Grazing systems for sheep

Dr Aurélie Aubry

Benefits of rotational strategies

Key Messages

- Rotational strategies can increase grass utilisation in sheep systems.
- A greater number of paddocks offers opportunities for silage production or higher stocking rates but may result in an increase in days to slaughter.
- Measuring weekly grass covers is crucial to inform grazing movements and grassland management, for example by identifying those fields that need either reseeding or soil management intervention.

Background

Grazed grass is the cheapest feed source for sheep farms in the UK and Ireland relative to silage and concentrate feeds. Previous research provided clear evidence of the benefits of rotational grazing compared to set stock systems. However, setting up rotational strategies can represent significant costs for farmers. This will be worth it because increasing grass utilisation by even just 1 t DM/ha can result in higher lamb output, representing an increase in profit estimated at more than £230 per ha per year. A key challenge is to determine the optimal number of paddocks to include within a given grazing system.

Research studies

As part of a recent project funded by DAERA and AgriSearch, a four and an eight rotational paddock grazing system were compared using the same number of ewes and grassland area at AFBI Hillsborough, over two consecutive years. A similar study was carried out on five commercial lowland farms up to weaning. The sheep farmers involved in the on-farm work also contributed to GrassCheck NI.

Research findings

The study in Hillsborough found that grass yields were higher from the eight-paddock system by 1t DM/ha/year, with no significant effect on grass quality. However, lambs grazing the four-paddock system had higher average daily gains from six weeks onwards, reaching slaughter 36 days earlier than those on the eight-paddock system. The on farm work found a similar pattern: higher grass production and utilisation on the eight-paddock systems and higher lamb growth on the four-paddock systems.

Farmers involved in the study appreciated the flexibility that the eight-paddock system offered, by being able to take paddocks in or out to respond to grass shortages or excesses. Measuring weekly grass covers is crucial to inform these decisions.

These results indicate that a greater number of paddocks offers opportunities for silage production or higher stocking rates but may result in an increase in days to slaughter. The ideal number of paddocks will therefore be different depending on flock size and slaughter targets.

Potential Impact for Farming for the Future

Improving grass utilisation using rotational strategies without significantly increasing the use of fertiliser or concentrate has the potential to reduce the carbon footprint of sheep production systems due to sustainable increase in lamb output.

This project was funded by DAERA and AgriSearch.

Agroforestry – integrating trees and grazing livestock for sustainable farming

Rodrigo Olave

Climate mitigation, adaptation and farm sustainability through integrating trees

Silvopastoral system at AFBI Loughgall, 22 years after tree planting.

Key Messages

- Agroforestry is a long-term commitment and planning is important.
- Tree selection is based on site suitability, combined with local knowledge.
- Agroforestry can add value to livestock and domestic timber products.
- Between 1.0 to 4.0 tonnes of carbon are sequestered per year from 50-100 trees/ha.

Background

Ecological and economic interactions from the integration of trees with agricultural crops and/or livestock on the same unit of land has been investigated in AFBI continuously since 1989. With ambitious government targets on afforestation, and strategies to mitigate against and adapt to climate change, agroforestry as an integrated livestock/forestry system can yield multiple production and environmental benefits.

Research studies

AFBI research has shown that tree species such as oak, poplar, sycamore, cherry and ash can be successfully integrated with livestock and pasture with a minimal impact on grassland management. In AFBI experimental trials, grass growth and livestock production under widely spaced trees were not reduced until the tree canopy expands beyond a certain diameter, analogous to when trees are approx. 13 years old. It has been modelled that under broadleaved trees planted at 5-meter spacing, grazing capacity will be reduced by 50% after 20 years; but grazing capacity will be longer in more widely spaced trees.

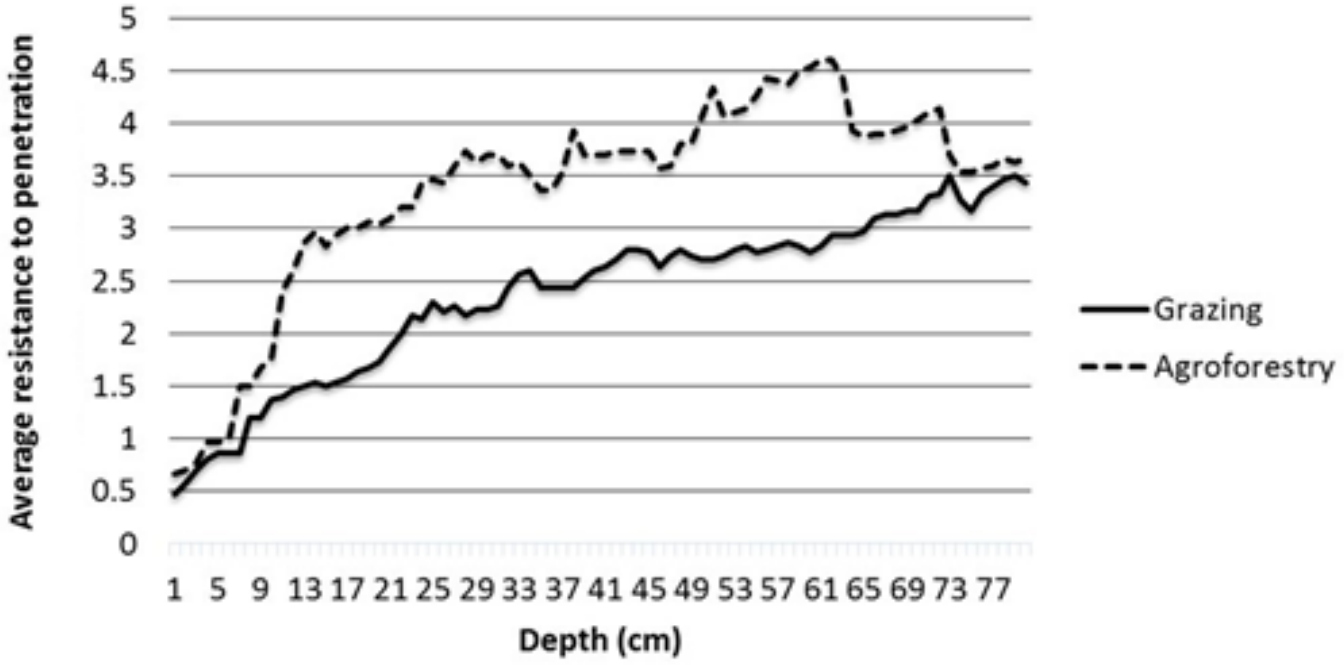


Fig 1. Infiltration potential is greater in the agroforestry, creating a soil profile more resistant than a grassland system.

Research findings

Trees grown in pasture can extend the grazing season, leading to improved grass utilisation and helping to reduce ammonia emissions and sequestered carbon in soils. Trees (of all species) at different densities, ranging from 100 to 400 trees/ha, provide grazing resilience during extreme rainfall by increasing soil infiltration rate (Figure 1). Agroforestry also alters relative functional microbial biodiversity, as well as increasing flora and fauna biodiversity , carbon sequestration; and provides a renewable energy product (biomass).

Other environmental benefits demonstrated in AFBI research include the shelter provided by trees, which reduces wind and temperature stress on livestock, provision of habitat and wildlife corridors, root differentiation, improved soil structure and less leaching of nutrients.

Poplar silvoarable system with wide tree alleys established in 1999 and that evolved into a silvopastoral system at AFBI Loughgall.

Potential Impact for Farming for the Future

Agroforestry systems have a positive economic and environmental benefit. On balance however, more work is needed to assess their use in high production cattle and sheep systems, as well as how to maximise both economic and environmental benefits over an extended period of time, ie more than 13-15 years.

Overall, the limited uptake to date on commercial farms across Northern Ireland has shown that agroforestry is a possible land use option, that can deliver multiple sustainability objectives in agricultural landscapes.

This work has been funded by DAERA, DAFM and Horizon 2020.

Role of virtual fence technology in livestock systems

Francis Lively and Conor Holohan

Virtual fence technology has potential to improve grassland management in a labour efficient manner

Key Messages

- Virtual fence technology uses a combination of audio and electrical stimuli to contain grazing livestock within a GPS boundary
- Research to date indicates that virtual fencing can be an effective and ethically acceptable technology for use with grazing livestock
- Virtual fencing could offer an alternative to physical fencing for sub dividing grazing platforms to improve grassland management, but reductions in the cost of the technology will be required to encourage uptake at a farm level.

Background

Improving grassland management has potential to enhance grass production and livestock performance; however, sub-dividing pasture and moving livestock regularly is deemed a labour intensive task on many farms, particularly beef and sheep. Virtual fencing (VF) is a technology which enables grazing livestock to be managed without the use of a physical fence. The system typically comprises a mobile phone application (through which the user sets the VF boundary) and a GPS-enabled neck collar. When the animal approaches the VF, it receives an audio warning to turn around. This is followed by an electric pulse if it proceeds beyond the VF.

There is significant potential for VF technology to facilitate managed grazing on farms, however there is a requirement that such technologies are reliable and adhere to high animal welfare standards.

Research Studies

Over the last 3 years, AFBI have conducted 7 studies using 300 animals, including growing cattle, suckler cows and calves, ewes and dairy cows. The primary focus of the studies has been to access the impact of the technology on animal welfare, however the effectiveness of the technology has also been evaluated.

Research Findings

Collectively, the data generated from this project has demonstrated that virtual fence technology is an effective means of containing groups of animals (cattle or sheep) within a set boundary in a welfare-friendly environment. The results have indicated that regardless of animal age, species, or environment they are able to be trained to use the equipment provided that they are trained to the virtual fence in a small paddock at the outset. Despite some individual animal variation only 1 animal in the complete group evaluated did not successfully train to use the virtual fence collars.

A possible explanation might have been that the animal might have been deaf. A range of grazing conditions was evaluated, and results would support the conclusion that virtual fencing can be a suitable replacement for electric fencing, offering a simpler and more labour efficient method for managing grasslands within both lowland and upland pasture with no difference in animal performance.

Although, the technology has proved to be successful the current cost of it relative to electric fencing will limit the uptake at a farm level unless prices drop, or grant aid is provided to assist farmers purchasing the equipment.

Potential Impact for future farming

The collection and analysis of this data has identified that research to date indicates that virtual fencing can be an effective and ethically acceptable technology for use with grazing livestock. Although the number of farms using virtual fencing in the UK and Ireland is relatively small at present, it could become commonplace in the coming years particularly as the technology is further refined and becomes more affordable, and the importance of social sustainability of farming increases.

This project was funded by DAERA and Horizon 2020