Grassland research – where to from here?

TEAGASC researchers examine how their work will help to meet some of the major challenges of modern and future food production from grassland.

In the last decade, the requirements on global food systems have shifted dramatically from a focus on quantity and food security, to meeting the growing needs of an increasing population in a manner that safeguards human health, protects the natural environment and provides a profitable livelihood for farmers. The global food system has a substantial environmental impact and is responsible for approximately 25 % of all greenhouse gases (GHGs) released by human activity. To an increasing extent, the diets of urban populations have become less varied, composed of an ever-greater proportion of high-energy, high-protein and processed products, which fail to deliver nutrition security. Today, one in nine people (some 821 million worldwide) have an insufficient calorie intake, and one in five (1.5 billion) suffer from micronutrient deficiencies, while more than 672 million adults are obese. The challenges for food production worldwide are substantial, and there is a pressing need to adapt both within the farm gate and through to the dietary and lifestyle choices of society. As part of the European Union, Ireland must progressively reduce its dependency on imported animal protein feed and fossil energy for mineral nitrogen (N) formulation, to further improve the efficiency of grazing while reducing the climatic and environmental impacts of such systems. The scope of this article is to outline how Irish grassland systems are adapting in parallel with research innovation efforts to contribute to meet these challenges, while continuing to retain the financial, people and animal welfare advantages of grazing systems.

Further developments in grazing management

Although grazing systems have specific challenges, such as unstable feed supply and reduced individual animal intake and performance, the principal benefit of improved grazing management has been to optimise the quantity and nutritive value of the forage consumed by grazing animals. Notwithstanding the substantial benefits of pasture-based systems, engaging more farmers in pasture measurement in support of more rapid and improved pasture management continues to be problematic. The ongoing development of the national PastureBase Ireland (PBI) database and pasture management systems have increased participation in pasture measurement among Irish farmers, resulting in increased intake and animal performance from pasture on farms. Applying technologies such as image analysis, satellite data analysis and radar, combined with machine learning, may offer the potential for real-time remote measurement of grassland, provide farmers with up-to-date information on pasture quantity and quality, and increase confidence and accuracy in terms of grazing management and supplementation decisions. The further development of pasture growth prediction to include more pasture species, real-time nutrient management decision supports, remote measurement and improvements to usability function will assist more farmers in engaging in pasture measurement and improved pasture management on Irish farms.

Forage breeding

The genetic improvement of forages plays a major role in the enhancement of agricultural systems. In the past, forage breeding has mainly focused on improving animal production, but now climate change mitigation and reducing the environmental impacts of farming are equally important. To this end, breeding will continue to focus on the predominant grass and legume species in Ireland – perennial ryegrass and white clover. However, balancing animal

production targets against the need to reduce the environmental and climatic footprint of farming poses further challenges. This may require traits expressed at levels outside the known range of variation in the currently popular species or even completely new traits. Breeders are currently investigating the genetic potential of novel forage species (e.g., bird's foot trefoil, sainfoin, lotus, chicory and plantain). These species are unlikely to completely replace the more productive species of today but in combination, the whole may be significantly greater than the sum of its parts. New research projects are already underway to identify new traits that can differentiate clovers, while the possibility of a bloat safe, high nitrogen (N) fixation persistent grass clover sward is a major goal. Plant breeding has traditionally moved steadily, albeit slowly. Characterising plant phenotypes is costly and time consuming, which represents a major bottleneck in the process. The advent of new technologies, including optical sensors, machine learning, low-cost genotyping, genome sequencing, and genomic selection facilitates high-throughput phenotyping and genotyping. These new technologies are expected to more than double the rate of genetic gain in perennial ryegrass and white clover. In novel forage species that have undergone very little formal breeding, the rate of genetic gain could be multiple times higher in the future. Future breeding may differentiate varieties for intensive and lower-input sustainable systems, and marginal environments. Greater emphasis will be placed on forage quality, disease and pest resistance, N- and phosphorus (P)-use efficiency, N fixation, root design, and anthelmintic and bloat safe properties.

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Legume-based swards

The incorporation of legumes and other plants in grazing swards to enhance atmospheric N fixation, reduce the use of synthetic fertilisers and pesticides, improve soil quality and enhance biodiversity is a significant ambition for Irish pasture-based systems. The impacts of legume incorporation within grazed swards are substantially increasing voluntary intake, organic matter digestibility, and energy and protein supply in grazed swards. The further development of grazing practices to increase legume content and persistence within grazing swards is a significant focus of ongoing research efforts. At a time when white clover inclusion in grassland swards in Ireland is low, despite the known benefits in terms of herbage and animal production and reduced N fertiliser use, the development of a Clover Profit Index, similar to the Pasture Profit Index (PPI), will provide farmers with confidence in selecting the appropriate white clover cultivars for their system. In future years, and depending on requirement, the development of selection indexes for other species may also be important for the industry.

Further characterisation of milk from grazing

In a context of increasing societal demand for more sustainable and ethical production systems, milk produced from grazing has become a key point of differentiation and the segmentation of dairy markets towards grazing systems is ongoing in many countries. While the distinctive nutritional properties of predominantly pasture-derived milk have received significant attention, the effects of plant- and animal-breeding programmes and sward species diversity on milk composition and functionality require further characterisation to quantify the variability of milk fine composition and technological properties in grazing dairy systems. Detailed pasture-based milk evaluation also has potential to identify accurate biomarkers, which can indicate both the nutritional status of the cow and the relative contribution of pasture to her diet.

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