

A decade of advances in grass quality provides a taste of what's to come

Plant breeding progress

For producers focused on generating more milk from grass, the past 10 years have been significant in terms of the improvements made in the performance of ryegrasses in particular. But what does the next decade have in store? We spoke to a leading grass breeder to find out more.

text **Matt Mellor**

Dry matter yield potential in the best available varieties has continued to increase during the past decade. But more significantly there have also been great strides forward in nutritional quality, as well as other desirable traits such as persistency and extended seasonal performance. Advancements in quality traits such as D-value – seen most notably since around 2000 with the emergence of the first high sugar ryegrasses – are the culmination of a change in breeding emphasis first adopted more than 20 years earlier. The fact that it takes, on average, around 12 years for a variety to progress from initial selection to the Recommended Lists explains the time lapse.

The good news is that the breeding programme responsible for a lot of the current progress is on-going and

promises even greater improvements to come during the next decade and beyond.

Adopted method

Richard Hayes is the current ryegrass variety breeder at the Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth University, where the idea of breeding ryegrasses for greater nutritional quality was first considered in the 1970s by his predecessor Pete Wilkins. Working as part of an experienced team at what was then still the Welsh Plant Breeding Station, Dr Wilkins began his quest for quality in earnest in 1983, introducing a plant breeding methodology not previously used in ryegrass.

“The method adopted by Dr Wilkins is called half sibling recurrent selection and we are still using it at IBERS today,” explains Dr Hayes.



Richard Hayes: “Modern breeding methods allow effective multi-trait selection”

“It is a far more focused method of breeding selection than the conventional paired crossing method typically used by ryegrass breeders everywhere else in the world. It allows us to work with relatively small numbers of plants and yet select for multiple traits concurrently. “It is more akin to what a producer would understand as a pedigree breeding programme, where the ‘mother’ plant equates to a bull of known genetics and is bred to many different cows or pollen donors in the case of the ryegrass.”



Ryegrass research: plant breeders use a focused method similar to a pedigree cattle breeding programme

This unique targeted ryegrass breeding methodology has been a key reason for advances seen in the past decade but – as Dr Hayes points out – so has the work of animal scientists alongside the plant breeders.

“The first real breakthrough came when the first Aber high sugar grass, AberDart, came onto the Recommended Lists in 1999,” he says. “This intermediate diploid perennial ryegrass variety had the superior dry matter yield and agronomic characteristics to excel among all contemporary varieties, but also showed a leap forward in D-value.”

Better performance

The improved D-value in AberDart is related to the increased water soluble carbohydrate (WSC) content, a trait first selected for by Dr Wilkins as part of his quest for improved quality back in the 1980s. Aber high sugar grasses, as they are now known, were tested in ‘proof of principle’ studies involving dairy cows to first establish that the improvements resulted in better animal performance. Once positive milk yield responses were established, the breeding programme had real focus and more and more varieties with superior WSC have been developed through the programme and are now featuring strongly on the Recommended Lists.

As a genuine breakthrough variety, AberDart was awarded the prestigious NIAB Variety Cup in 2003 for progress in quality traits – the first forage variety to attain this honour – and as such heralded much of the subsequent progress seen during the past decade.

This is summarised in Figure 1, which shows the introduction of later heading diploids, starting with AberAvon, and a continuing improvement in the intermediate diploids. The IBERS programme has also produced high sugar hybrid ryegrasses, notably AberEcho, and most recently has used techniques to make these advanced quality characteristics available in high sugar

variety	first listed on RL	grazing D-value	grazing yield (t/ha)	conservation yield (t/ha)	aftermath D-value
Fennema	1987	72.5	9.82	14.58	73.7
Premium	1998	73.3	10.31	15.01	73.2
AberDart	1999	76.0	11.00	16.01	75.7
AberStar	2005	76.3	11.31	16.46	76.0
AberMagic	2008	76.5	11.46	16.68	76.1
AberGreen	2011	76.6	11.57	16.84	76.3
AberWolf	2014 *	76.9	11.93	17.37	76.6
Ba 14150**	2019***	77.7	12.68	18.46	77.2

* Variety being considered for RL listing in this year; ** Projections from early selection and breeding data only; *** Estimate of consideration for RL.

Table 1: Progress in DM yield in D-value in intermediate perennial ryegrass varieties (source: IBERS selection and breeding trials data).

tetraploid perennials, exemplified by the 2009 Recommended List entry AberBite and the most recent new arrival AberGain.

Alongside the pursuit of higher water soluble carbohydrate content, the breeding methodology at IBERS has enable concurrent selection for other traits, including resistance to key diseases, such as crown rust, and also to improve key producer requirements such as persistency and extended seasonal growth.

“Dry matter yield and persistency are typically antagonistic traits in ryegrass,” explains Dr Hayes, “which means often one increases as the other decreases and in conventional breeding programmes it is difficult to overcome this.

“Using half sibling recurrent selection, we’ve been able to split these traits and – using data gathered on our long-term trials sites – it’s been possible to improve both yield and persistency. AberWolf, which will be considered for the Recommended List in 2014, is a great example of success in this area.”

Protein quality

The ability to select for, and improve, multiple traits concurrently continues to create opportunities for Dr Hayes and his colleagues to continually improve the nutritional quality of ryegrasses. Working in tandem with animal scientists,

everything from protein quality to vitamin content is firmly on the agenda. “Alongside increasing the water soluble carbohydrate content we have been improving protein quality,” he adds. “A large proportion of the protein in plants is in the form of a protein called rubisco, most of this being unavailable to the animal, and hence the notoriously poor utilisation – and high levels of wastage – by ruminants. Progress in this area is exemplified in AberGreen, where nearly all of the rubisco is soluble and therefore more available to the animal. The protein-to-energy balance in this intermediate diploid, which entered the Recommended List in 2011, is another step forward.”

Novel traits

Within the IBERS ryegrass breeding programme, as many as 50 traits will be involved at any one time, with nutritional aspects such as fibre digestibility already being improved alongside WSC and protein, for example. Going forward, Dr Hayes is looking at many other novel traits including lipid content – something already proven to boost animal performance whilst also reducing ruminant emissions – and also plans to enhance vitamin content. Also on the agenda is the use of high sugar grass for bio-energy production and bio-refining, something that may interest producers in years to come.

Since November 2012, genomic selection – familiar to producers focused on cattle breeding – is being incorporated into the grass breeding programme at IBERS.

Genomic selection will accelerate the progress being made, and bring many of the new developments being worked on into practical application even more quickly. For producers seeking more milk from grass, the future looks bright indeed. |

Figure 1: Ryegrass breeding timeline

