

From Root to Rumen :

New Grass and Clover Varieties for Profitable and Sustainable Livestock Production

How are farmers going to produce more home grown feed when the climate is changing, and maintain profits when feed and fertilisers prices are increasing?

Four grass and clover breeding projects aim to help mitigate and adapt to climate change challenges by improving performance and reducing losses through water use, nitrogen and phosphorus use efficiency from 'root to rumen'. Through gaining a better understanding of both the functions and the genetic control of these resources in plants, breeders are developing varieties for the 21st century that will give higher yield and quality with lower inputs and costs to help feed a growing population.

Water Use Efficiency In Grasses

Using natural methods, fescue genes from around the globe have been introduced into Italian and perennial ryegrasses giving novel hybrids that combine the quality and yield of the ryegrass with the water resilience of the fescues. New lines have rapid and high root growth that improves water use efficiency; the amount of water needed (for each kg of growth) for soil carbon sequestration and flood control.

One new variety stood out showing improved sugars (water soluble carbohydrate WSC), yield and D value and 80% better water use than the Italian ryegrass/ fescue control variety. Code named BB2540, the candidate variety has greater rooting capacity than controls and will enter into National list testing this year (2013). The identical fescue genes for drought tolerance have an equivalent benefit in perennial ryegrass for water-use-efficiency and a candidate drought tolerant perennial ryegrass variety is expected for entry into National list testing in 2016.

Water Use Efficiency in white clover

Drought tolerant Caucasian clover, which has rhizomes not stolons, has been crossed with white clover to improve water use efficiency. Initially successful with a small leaved clover suitable for grazing, it is hoped that rhizomatous medium and large leaved drought tolerant clovers can be bred in future.

One variety code name AX 17 has entered National list trials

Nitrogen Use Efficiency of Perennial Ryegrass and Clover

Cattle and sheep are poor converters of grass protein (nitrogen) into meat and milk, about 80% of the protein eaten is excreted as faeces and urine! This is costly to feed and can lead to high N levels in soils, air and water. Protein use can be improved by creating a better balance between energy and protein which improves rumen efficiency

Perennial Ryegrass

More grass protein is converted to meat and milk when readily available energy is provided as grass enters the rumen. Energy is usually slowly released by the digestion of tough grass cell walls, however new varieties of 'high sugar' perennial ryegrass have been bred to provide more readily available energy. These grasses also deliver better dry matter intake, digestibility, higher milk production and faster liveweight gains together with higher grass yields which can cut feed bills, improve carbon footprint and farm profit

The water soluble carbohydrate (WSC) content in the best new intermediate heading variety Aber Wolf is 10% greater than in the control variety. This is currently in National List Trials and it is anticipated that it will be launched in 2014. AberZeus also intermediate heading entered National list testing and if successful will be launched in 2016. A late heading variety (code BA 14088) is also entering national list testing.

High Sugar Grasses and Potential for Biofuel Production

A spin off of breeding for increased sugars is improved potential for alcohol based biofuel production from grass. This is part of the IBERS Grassohol project with AberMagic yielding 5000l/ha, 2000l/ha more than the 1998 variety Premium

Improving Rumen Efficiency

The latest varieties of grass and clover are being tested in livestock trials in 2013 to examine the effect of grass variety and grass/clover mix on excretion of dietary protein.

Phosphate Use Efficiency (PUE)

Phosphate is a key nutrient for both plant and animal growth. The main fertiliser source is mined rock phosphate which is forecast to run out in the next 50-120 years and prices have tripled in the last 10 years.

By testing grass and clover varieties for PUE under high and low inputs of phosphorous more efficient varieties have been developed and IBERS will continue the work on the Rothampsted Research N Wyke experimental farm platform.

Two clover varieties with low phosphorous needs will be tested for any effects on livestock.

White clover varieties from plants selected on soils with low P (Bronydd Mawr) have been developed and will be entered for National list testing

Improvements in Digestibility and Dry Matter Yield in intermediate perennial ryegrass varieties

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

Source: IBERS selection and breeding trials data.

§ Variety being considered for RL listing in this year.

¥ Projections from early selection and breeding data only.

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Clover

Another approach to create a better balance between energy and protein in the rumen is to reduce the crude protein content of the diet to improve rumen efficiency. This is particularly difficult to manage when stock are grazing. Clover provides a high quality feed which improves intake and digestibility of the diet, fixes nitrogen, grows well in mid summer when grass growth is slowing down and can improve soil structure.

White Clover

Research has shown that the variation in protein content in white clover gene pools was greater than expected and new varieties are being developed in trials in mixed grass white clover swards to mimic farming systems. One code named AC 4835 has been entered for NL trials, it has crude protein (CP) levels 5-10% below current varieties on the market.

Red Clover

A new low nitrate leaching line of red clover has been developed and is being grown in field experiments to compare the differences in nitrogen leaching in comparison with a “ typical” red clover variety

A key message from early results highlight reduced leaching when red clover is grown with hybrid ryegrass, as the ryegrass uses some of the nitrogen produced.

Red clover contains an enzyme polyphenol oxidase (PPO) that can reduce N losses. There is variation in activity in PPO between and within red clover varieties and new red clover varieties with appropriate levels of PPO to reduce N losses are being developed

Improving Rumen Efficiency

The latest of grass and clover are being tested in livestock trials during 2013 to examine the effect of grass variety and grass /clover mix on excretion of dietary protein.

Phosphate Use Efficiency (PUE)

Phosphate is a key nutrient for both plant and animal growth. The main source is mined rock phosphate a non-renewable resource which is forecast to run out in the next 50 -120 years. Prices have tripled in the last 10 years

Researchers have focussed on testing forage species for PUE under both high and low inputs of phosphorous IBERS will continue the work on the North Wyke experimental farm platform in Devon.

Two clover varieties with low phosphorous requirements will be tested on livestock.

White clover varieties from plants selected on soils with low P (Bronydd Mawr) have been developed and will be entered for National list testing