

PHENOGRASS – The Phenology of Perennial Ryegrass and its Potential Contribution to Grassland Carbon Sequestration

Authors: Jonathan Yearsley, Rainer Melzer and Carl Frisk

Identifying pressures

Agricultural grasslands are a crucial part of Ireland's agro-economy. Within these grasslands, perennial ryegrass (*Lolium perenne*) is the dominant species and underpins much of their performance, of which the timing of growth (i.e. the phenology of grasslands) is an important aspect. A late start or an early end to the growing season requires grazing livestock to be housed for longer, which in turn requires farmers to have additional reserves of forage. These reserves also depend on the length of the grass growing season. Seasons with exceptionally late starts and those with poor forage harvests have been major contributory factors to past fodder crises, such as the 2013 fodder crisis, with broad consequences for the economy, animal welfare and human well-being.

Informing policy

It is imperative to ask: how will future climate conditions, including increases in temperature and CO₂ and the increasing possibility of extreme weather events such as flooding, impact the performance of perennial ryegrass?

Ryegrass was found to be very resilient to increased temperatures and CO₂ concentrations. Biomass accumulation and leaf appearance did not change substantially under modelled future climatic conditions. We observed a small positive effect on ryegrass growth towards the end of the growing season in September under elevated temperatures, leading to a slight lengthening of the growing season.

However, waterlogging had a far more dramatic effect on biomass accumulation and leaf appearance. All cultivars tested showed a drastically reduced performance when waterlogged.

Taken together, our study shows that small beneficial effects resulting from increases in temperature and CO₂ cannot compensate for yield losses due to severe flooding events.

Developing solutions

We were able to study ryegrass performance under future climatic conditions with great precision using growth chambers that allowed targeted manipulation of temperature and CO₂ levels. We also included data from satellite images of Irish ryegrass pastures in our analysis. Satellite imagery provides data on every part of Ireland and could contribute to national monitoring schemes.

Future breeding programmes should focus on waterlogging resilience as an important trait. Some small gains in yield might be possible if the impact of extreme weather conditions such as flooding can be mitigated. Substantial yield gains due to increased temperatures and CO₂ concentrations should not be expected.

Satellite remote-sensing data allows current and past grassland phenology in Ireland to be quantified across Ireland at a relatively low cost and with high precision. Work is needed to validate approaches with ground-based phenological observations and to link estimated phenology with environmental variables.

