ResilientCrop: Perennial ryegrass pasture systems and Climate Change Readiness

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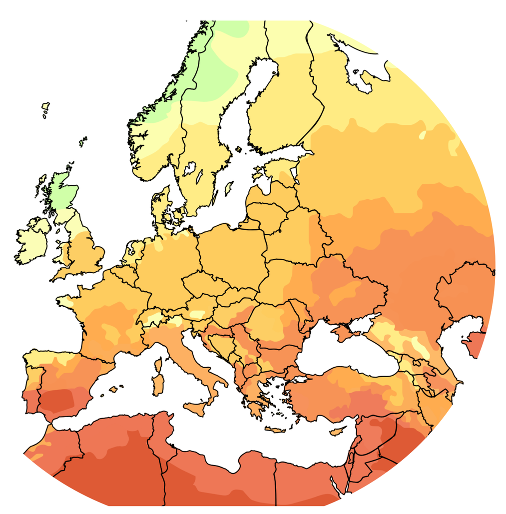
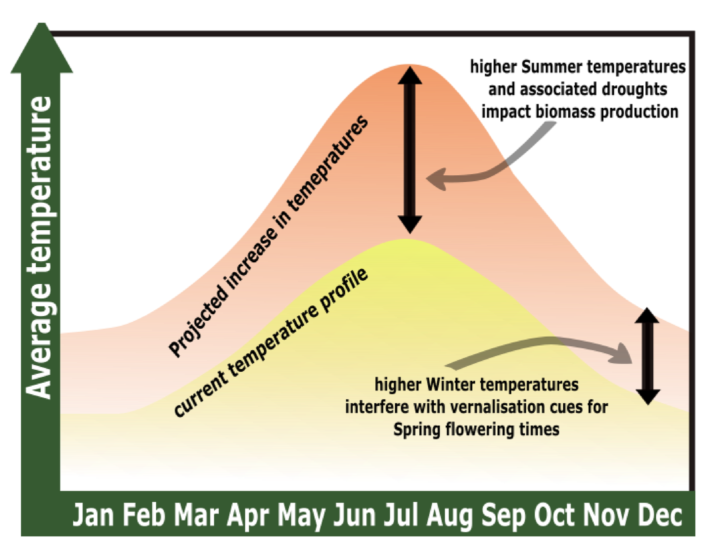
THE CHALLENGE

Global Climate Change

Global Climate Change is set to accelerate the frequency of **extreme weather events** worldwide, with Europe becoming progressively warmer and more prone to **droughts.**



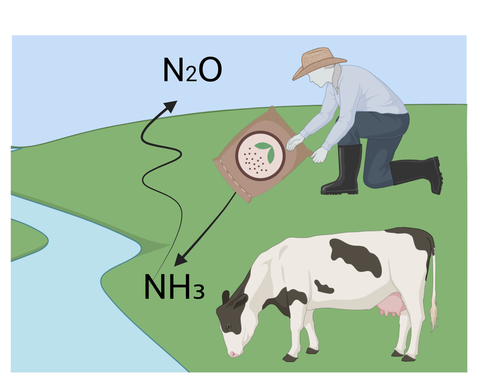
Climate and Irish Pastures



Changes in precipitation and temperature patterns are going to **threaten the reliability of plant productivity,** and in turn food security and economic stability.

The Irish agricultural system is based on **pasture grazing** optimised to rely on water-abundant grass growing seasons

Lack of Genetic Diversity



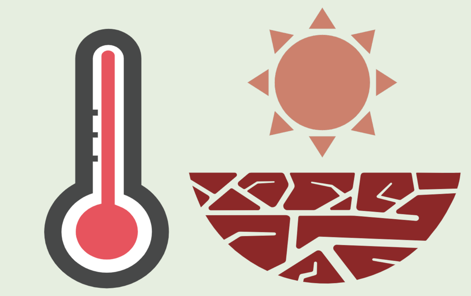
Irish perennial ryegrass varieties are **bred for maximum productivity under optimal conditions**, but lack resilience under stress.

On top of abundant and reliable rainfall, perennial ryegrass varieties also require **Nitrogen fertiliser,** which is costly, and is responsible for multiple types of **pollution** such as Nitrous oxide and carbon dioxide emissions.

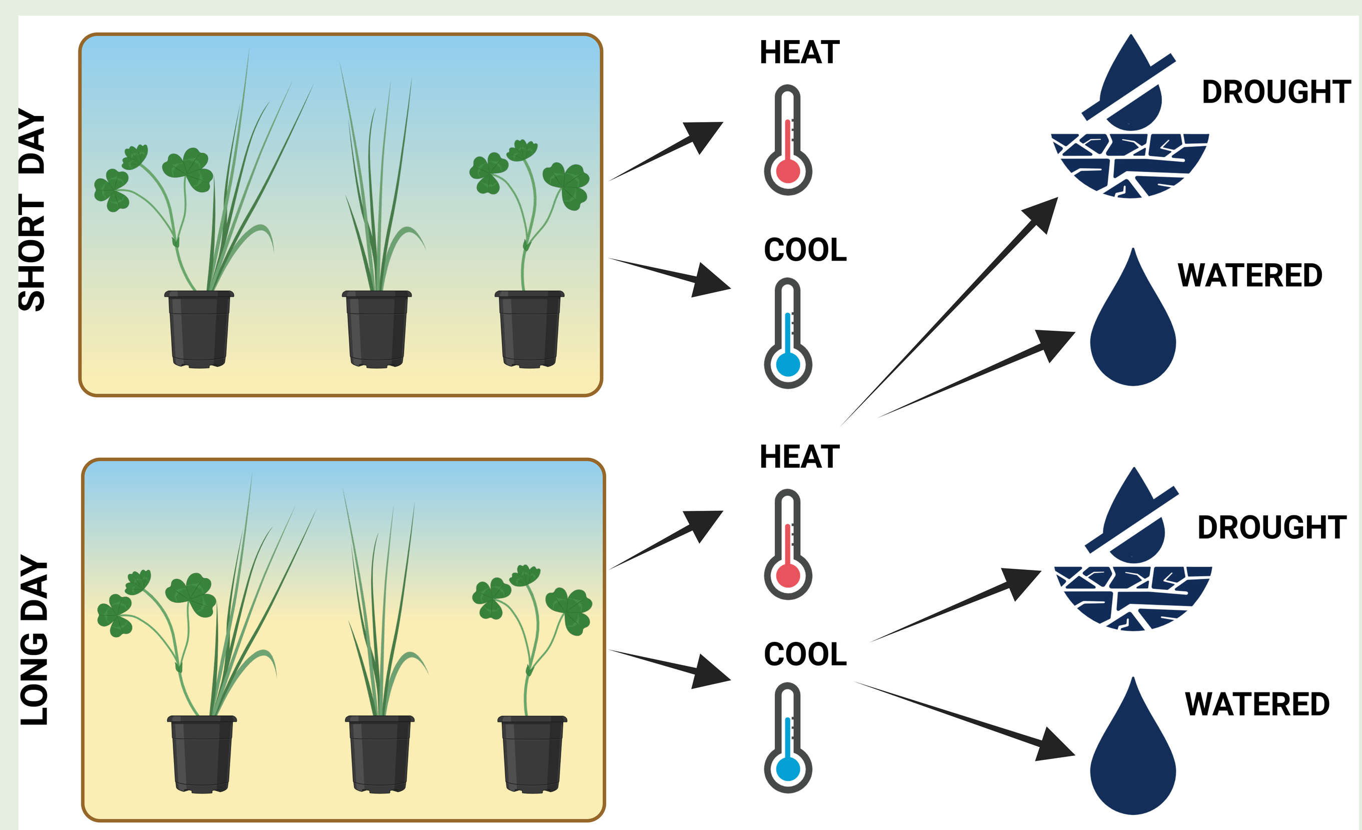
THE APPROACH

Collecting Ryegrass Genetic Diversity

We will source **ecotypes** of perennial ryegrass (*Lolium perenne*) from location across **Ireland and the UK**, and **Mediterranean countries** already experiencing intense seasonal droughts. We are expecting to identify **drought and heat stress- resistance** regulator that will inform future **crop breeding** programs.



Recreating Climate Stress in the Lab



The ecotypes will be grown in controlled laboratory conditions and subjected to combinations of **3 abiotic stressors (temperature, day length, & drought)** to mimic different growth condition scenarios in the field across seasons.

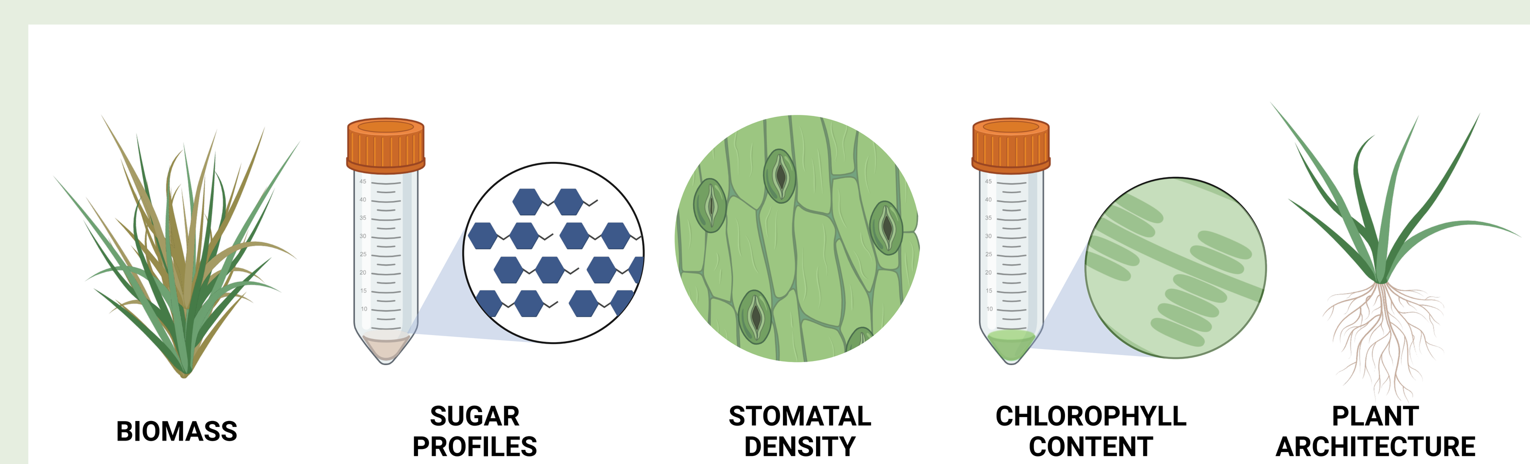
Perennial ryegrass will be paired with a **forage legume**, white clover, to study **interactions** between of the two species under stress.

The responses of both species will be characterised, and the best performing perennial ryegrass ecotypes will be selected for more in depth study of the molecular **mechanisms responsible for stress resilience.**

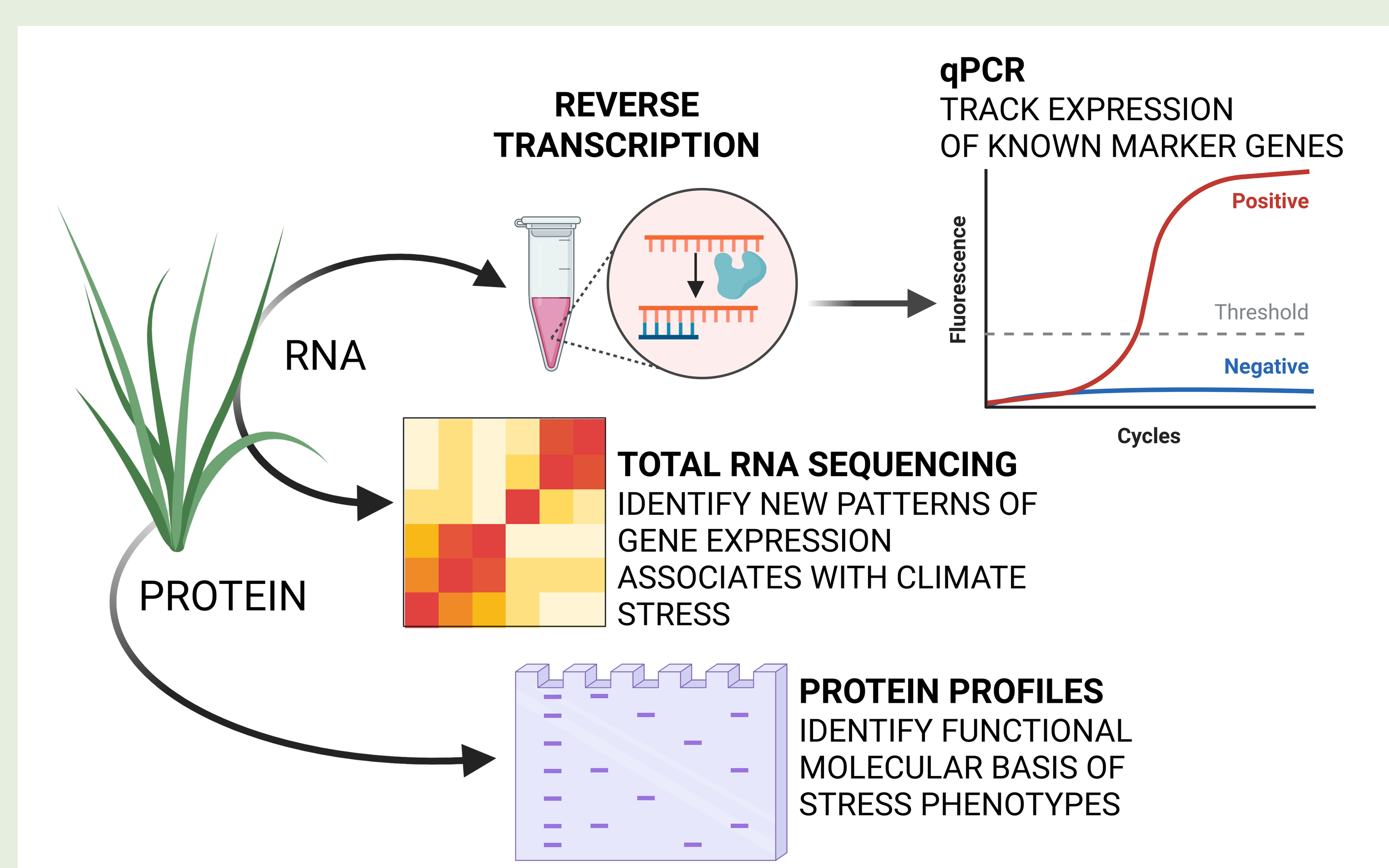
Physiology of Climate Stress

We will combine **physiological and molecular data** to identify regulators associated with stress-resilience.

Plant responses to stress will be characterised through **multiple parameters,** to **identify key differences** between stress-adapted ecotypes and traditional commercial varieties.



Gene Expression Tracking



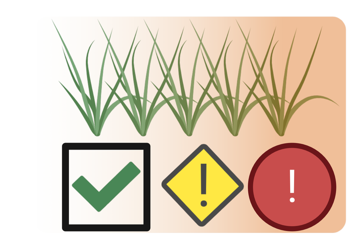
Gene expression analysis, by total RNA sequencing and qPCR tracking of target genes, will be performed to identify the signalling and transcriptional cascades that lead to observed phenotypes.

Protein profiles will be analysed to identify functional shifts correlated with stress-relevant phenotypes.

Identification of **molecular hubs** in stress resilience will be used to inform proof -of-concept genetic manipulation experiments.

THE OUTPUTS

In-field markers of climate stress

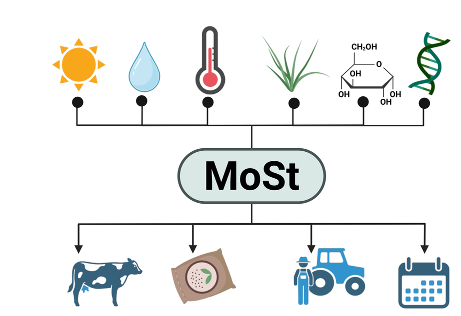


RNA from plants in field conditions can be used as an early marker of stress status.

We will develop **targeted primers** to screen for the **expression of genes** key to stress responses, to be used as a tool in **crop diagnostics**.

Input into MoSt Grass Management Model

Our findings will be incorporated into Teagasc's **Grassland management** model, MoSt.



To improve advice to farmers.

Inform climate-ready breeding

Stress phenotyping of diverse ecotype panel will inform climate-resilience **breeding programs**.

Optimisation of Sward Composition

Perennial ryegrass co-cultivation experiments with white clover will inform **sward composition** and **fertiliser application** strategies.