Plotting the future: a cereal walk

Tuesday 7th July

The James Hutton Institute, Balruddery Farm

The James Hutton Institute

INTERNATIONAL BARLEY HUB

Sponsor

SSCR Scottish Society for Crop Research

The **International Barley Hub (IBH)** is a platform to promote excellence in barley science and promote collaboration across the scientific, industrial and commercial sectors. Our goal is to generate new discoveries and their effective translation into wider economic, social and commercial benefits. Through this research and application, we aim to improve the resilience and sustainability of barley crop production and mitigate impacts of climate and environmental change.

Funders

The International Barley Hub receives support from a number of sources.

Large contributions to barley research funding have come from the Scottish Government's Rural and Environment Science and Analytical Services (RESAS) and have been supplemented by competitive research awards from BBSRC, EU H2020, SUSCROP, DEFRA, The Crop Trust, DivSeek International Network, AHDB, GCRF, EastBio, James Hutton Limited, the European Research Council, The Mylnefield Trust and other charitable organisations.

TAYCITIES
Smarter + Fairer

Funded by UK Government

Scottish Government
Riaghaltas na h-Alba
gov.scot

Find out more here!

Economic impact

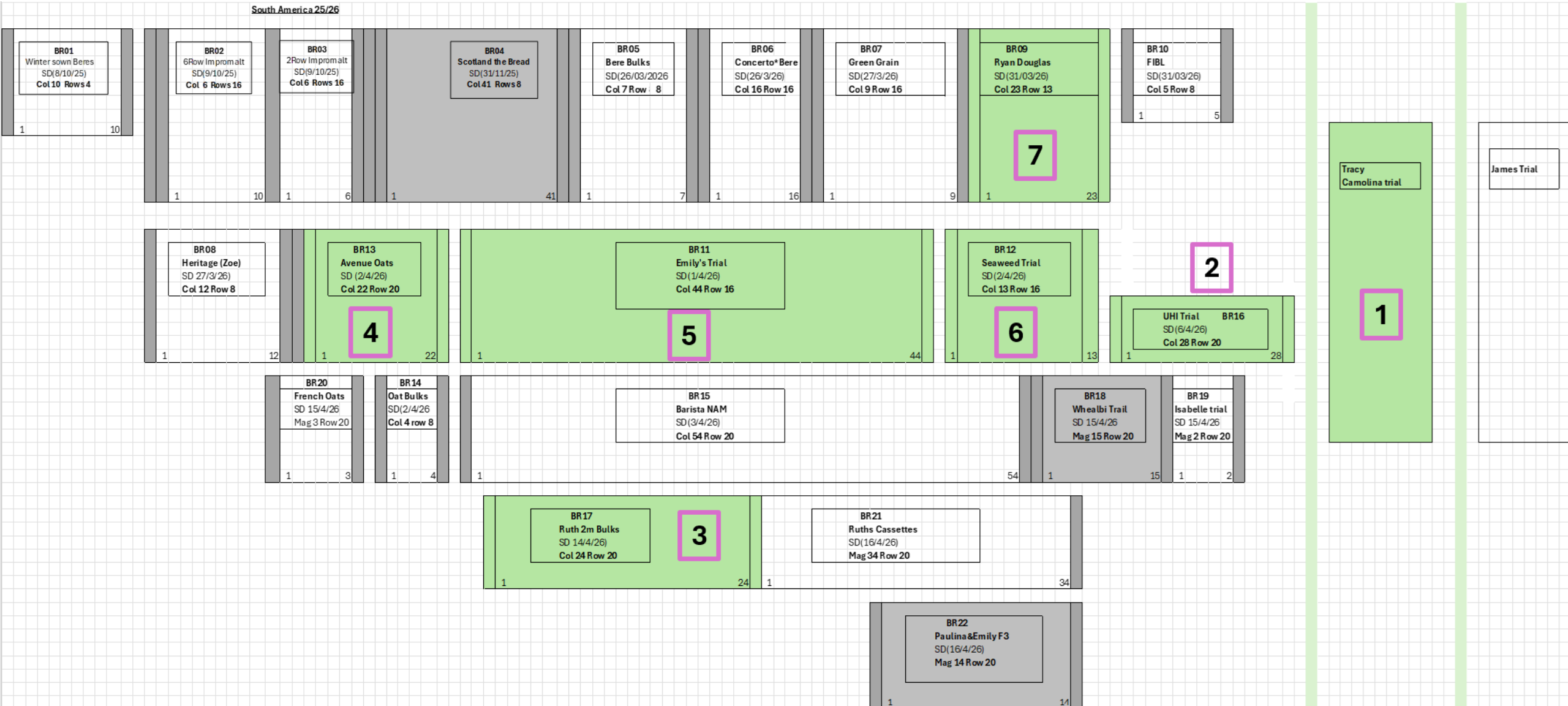
£40 MILLION

The IBH received an initial £40 million investment to develop an institute-led innovation centre project as part of the Tay Cities Region Deal funding.

£18.02 RETURN

The IBH is expected to provide an £18.04 return for every £1 invested.

Tour route


South America 25/26
BR01
Winter sown Beres
SD(8/10/25)
Col 10 Rows 4
1
10
BR02
6Row Impromalt
SD(9/10/25)
Col 6 Rows 16
1
10
BR03
2Row Impromalt
SD(9/10/25)
Col 6 Rows 16
1
6
BR04
Scotland the Bread
SD(31/11/25)
Col 41 Rows 8
1
41
BR05
Bere Bulks
SD(26/03/2026
Col 7 Row 8
1
7
BR06
Concerto* Bere
SD(26/3/26)
Col 16 Row 16
1
16
BR07
Green Grain
SD(27/3/26)
Col 9 Row 16
1
9
BR09
Ryan Douglas
SD(31/03/26)
Col 23 Row 13
7
1
23
BR10
FIBL
SD(31/03/26)
Col 5 Row 8
1
5
Tracy
Camolina trial
1
James Trial
BR08
Heritage (Zoe)
SD 27/3/26)
Col 12 Row 8
1
12
BR13
Avenue Oats
SD (2/4/26)
Col 22 Row 20
4
1
22
BR11
Emily's Trial
SD(1/4/26)
Col 44 Row 16
5
1
44
BR12
Seaweed Trial
SD(2/4/26)
Col 13 Row 16
6
1
13
2
UHI Trial
BR16
SD(6/4/26)
Col 28 Row 20
1
28
BR20
French Oats
SD 15/4/26
Mag 3 Row 20
1
3
BR14
Oat Bulks
SD(2/4/26
Col 4 row 8
1
4
BR15
Barista NAM
SD(3/4/26)
Col 54 Row 20
1
54
BR18
Whealbi Trail
SD 15/4/26
Mag 15 Row 20
1
15
BR19
Isabelle trial
SD 15/4/26
Mag 2 Row 20
1
2
BR17
Ruth 2m Bulks
SD 14/4/26)
Col 24 Row 20
3
1
24
BR21
Ruths Cassettes
SD(16/4/26)
Mag 34 Row 20
1
34
BR22
Paulina&Emily F3
SD(16/4/26)
Mag 14 Row 20
1
14

Tracy Valentine - Camelina : A potential new oil seed for Sustainable Aviation Fuel (SAF) in Scotland

Funding and partners: RESAS Responsive Research Fund – Scottish Energy Department

Seed from REGENRATE, HODMEDODS, Hurrells Seeds.

Finding alternative options for fossil fuels that do not compete directly with food or barley production for distilling is a key issue for the transformation of transport under climate change adaption. Sustainable aviation fuel can be produced from multiple sources of material. Here we are trialling an Oil seed – Camelina and some other oil seed alternatives to investigate the potential of producing feedstock of oil for a biorefinery potentially to be developed at the Grangemouth sites as part of the Just Transition Project Willow. The trials are aimed at understanding the basic needs and agronomy necessary to produce Camelina in Scotland, under future agricultural systems. We are therefore trialling low nutrient inputs, intercropping as well as drilling in both autumn and winter. Results will help the Scottish government decide whether this is truly an option for Scottish SAF production.

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Name of Trial: Camelina : A potential new oil seed for Sustainable Aviation Fuel (SAF) in Scotland

Name of presenter: Tracy Valentine

Number of plots, replicates and treatment: Five trials – 1) Variable drilling dates x drilling density (50 plots x 6 replicates), 2) Inputs (N, S, & weed control: 14 plots x 5 replicates), 3) Winter intercropping (Winter wheat x 2 & winter barley x 2: 9 plots x 5 replicates) 4) Spring Intercropping (Pea, Bean, Spring barley x 2, 2 types spring camelina, safflower (alternative oil seed) 5) Alternatives (Autumn drilled alternatives – winter linseed, safflower, spring & winter camelina : 4 plots x 5 replicates).

Germsplasm or variety: Camelina – Joelle, Zuzana & Hodmedods, Safflower (unknown); Spring barley - Laureate, KWS Sassy; Pea - Daytona, Bean - Scotch bean, Winter wheat , Winter barley – Buccanear, LG Caravelle, Winter wheat – LG Skyscraper, Graham

Traits measured: Growth stages & plant size– emergence, tillering (cereals), rosette diameter (Camelina & Safflower), height, time to flowering / anthesis, seed maturity.

Searching Northwards for Spring Barley Varieties adapted to Scotland

Academic partners: University of the Highlands and Islands, The James Hutton Institute

Funding body: Scottish Government, Mains of Loirston Charitable Trust.

Orkney's hyper-oceanic climate and northern latitude mean that varieties performing well in breeding trials down south may not be well suited locally. Regional priorities differ from those in eastern England where most the UK's cereal breeding programmes are centralised. In Orkney there is greater emphasis on earliness, lodging resistance, and straw yield due to challenging growing conditions and the high density of beef cattle.

This project assesses spring barley varieties from Finland, Sweden, and Norway for their suitability to Scottish conditions. These are evaluated alongside current commercial varieties and traditional bere barley in field trials running from 2026 to 2028. The trials examine responses to different fertiliser and fungicide programmes and are conducted at UHI Orkney (Kirkwall) and The James Hutton Institute (Dundee), enabling comparisons across contrasting environments.

By producing locally relevant evidence, the project aims to support farmers in adopting more economically and environmentally sustainable practices.

Name of Trial: Searching Northwards for Spring Barley Varieties adapted to Scotland

Name of presenter: Henry Creissen (University of the Highlands and Islands)

Number of plots, replicates and treatments: 2 N rates 55 and 110 kg N/ha, Fungicide treated (1 spray at T2) and untreated plots. 4 replicates

Germplasm or variety: 17 Scandinavian varieties provided by breeders Boreal, Lantmannen, Graminor, 2 UK varieties, 1 UK landrace (bere)

Traits measured: Emergence, Establishment, Plant Height, Heading and Maturity dates, Lodging/Brackling, Green Leaf Area, Disease, Grain yield, TGW, HLW

Ruth Hamilton: R-Evolve- Rapid evolution of wild barley
BBSRC funded project
EU COUSIN project funded by Horizon Europe and UKRI

This project, co-funded by Scottish Government through the Rural and Environment Science and Analytical Services (RESAS) Division and UKRI, is investigating the merits of a radically different approach to refreshing the diversity in the genetically eroded barley breeding gene pool. We are evaluating a novel improvement strategy that involves speeding up the process of harnessing traits from wild barley genotypes and incorporating them into the genome of commercial varieties required for NW European agriculture. The novel strategy we are exploring tests whether we can efficiently retrieve valuable genetic biodiversity from wild barley species.

By re-introducing 'lost' genetic biodiversity into the barley breeding gene pool, we believe there is an opportunity to increase resilience to our changing climate alongside associated environmental and regulatory issues (e.g. GHG emissions) while maintaining current levels of production. The strategy involved selecting 11 of the most diverse genotypes from across the geographical range to act as recipients of key 'domestication genes' from a popular contemporary barley cultivar (cv. 'RGT Planet') by traditional crossing. We used molecular markers to identify plants containing desired combinations of domestications genes in the earliest possible generation, non-shattering, spring growth habit and plant height. We then allowed selected individuals derived from each of the original ten plant families to self-fertilise for five more generations to generate a collection of over 2500 genetically fixed lines.
The population was grown as a two-rep plot trial in 2025 to evaluate field performance. This year we are growing the population in trials comparing performance under standard and direct drill cultivation (in a different field) and bulking seed to test other traits such as low fertilizer. We will also screen the population through the EU COUSIN project to look for novel root traits, to assess if lost diversity could provide stress resistance.

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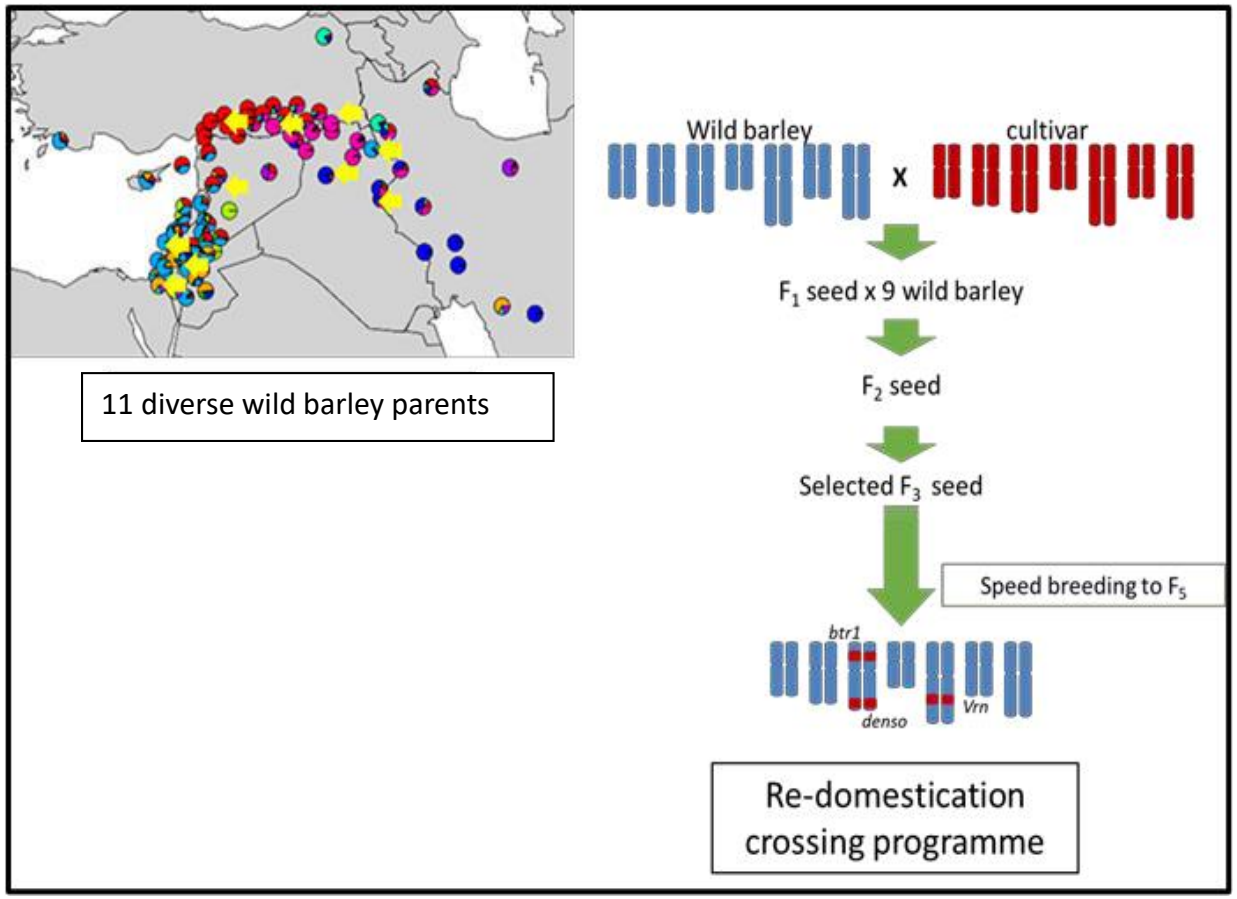
Name of Trial: R-Evolve- Rapid evolution of wild barley

Name of presenter: Ruth Hamilton

Number of plots, replicates and treatments: 236 lines and 2 replicates with RGT Planet as controls

Germplasm or variety: Crosses between 11 wild barleys from the middle east with RGT Planet selected for domestication traits
Traits measured: Establishment, flowering, height and post-harvest grain characteristics including yield



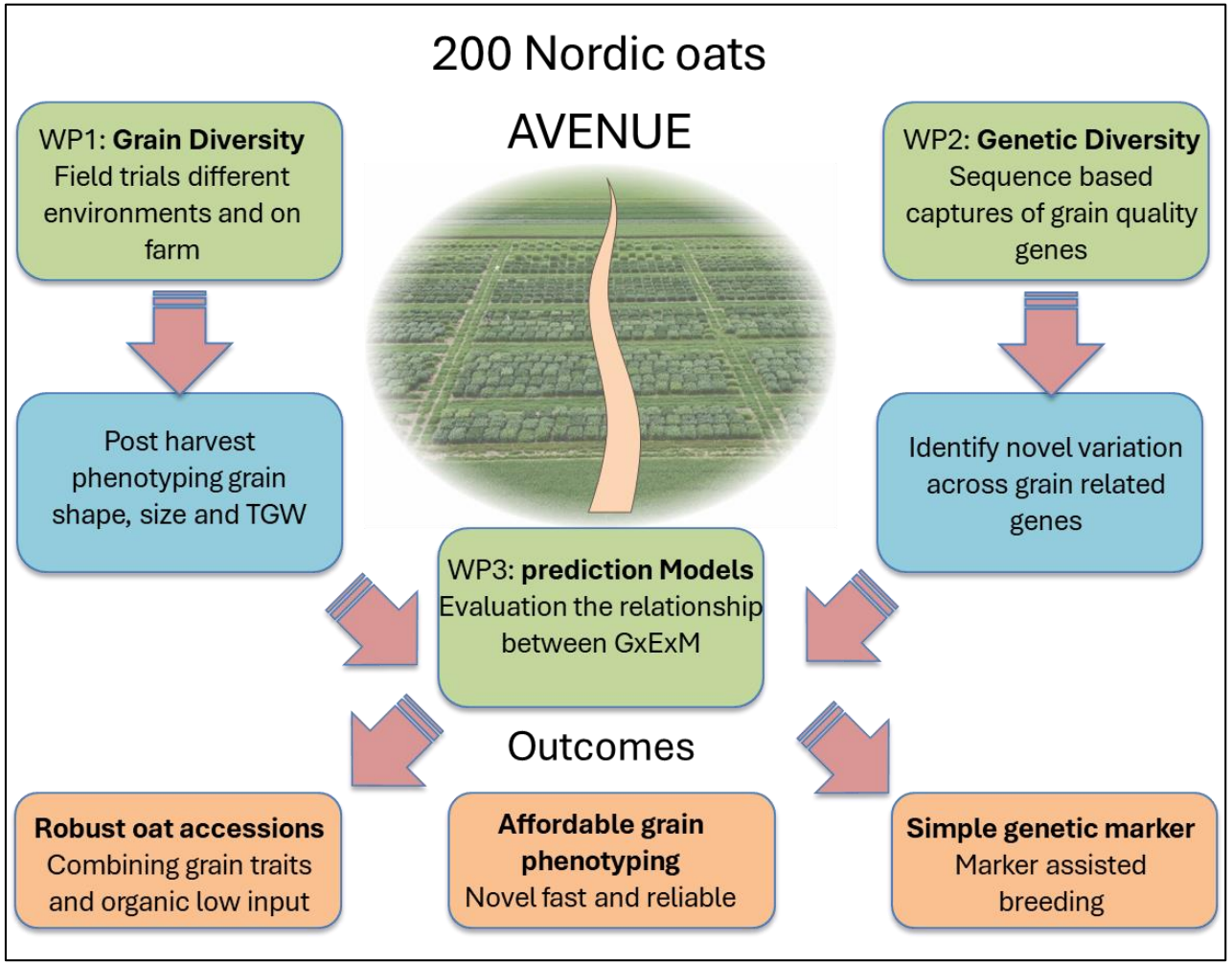
BBSRC bioscience for the future

RESAS

cousin

Miriam Schreiber - AVENUE: Breeding organic *Avena Sativa* L. (Oat) with high nutritional value.

The project, AVENUE, has been funded by the Novo Nordisk Foundation and is a collaboration between The James Hutton Institute, the Innovation Centre for Organic Agriculture and University of Aarhus in Denmark and Nordgen in Sweden. Oat is a priority crop for sustainable high-yield agriculture and has traditionally been considered a low-input crop. Additionally, oats are among the healthiest grains on earth, rich in protein, minerals, antioxidants, and β-glucan fibre, being associated with reductions in cholesterol levels and post-meal glycaemic responses. The project aims to address the need for oat varieties with high nutritional value specifically tailored to sustainable organic production. To achieve this, we are evaluating 200 oat varieties and landraces that have been collected from across the Nordic region and grown for a century surviving change in climate and agricultural practices. These accessions will be genotyped for key gene family members involved in β-glucan synthesis and scored for a range of grain quality traits under local environmental conditions. The combined dataset will be evaluated using state-of-the-art novel modelling approaches to identify nutritionally superior and yield-stable oat accessions, providing valuable novel germplasm for breeders.



Name of Trial: Breeding organic Avena Sativa L. (Oat) with high nutritional value (AVENUE)

Name of presenter: Miriam Schreiber

Number of plots, replicates and treatments: 200 Nordic old cultivars and landraces, replicated and with low inputs (50kg/ha, no fungicides or pesticides)

Germplasm or variety: Genebank collected Nordic lines to represent adaptation to Nordic conditions

Traits measured: Establishment, flowering, height and post harvest grain characteristics including yield, grain nitrogen and beta glucan

Innovationscenter for Økologisk Landbrug

NordGen

AARHUS UNIVERSITY
CENTER FOR QUANTITATIVE GENETICS AND GENOMICS

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Novo Nordisk Fonden

Emily Lyon (student): Malting quality in a changing climate

Industrial partner: RAGT

Academic partners: The James Hutton Institute and University of Dundee

Industry-standard malt production requires uniform grains with appropriate grain structure and composition. However, increasing environmental variation caused by climate change has clear impacts on malting barley crop yields and quality. To breed malting varieties resilient to climate change, we need a better understanding of the genetic and environmental factors which regulate malt quality, in particular the factors that influence the critical early stages of malt production. Barley grains are initially soaked in water to promote germination (steeping stage) and quick, even water uptake across the batch during steeping is critical for homogenous germination and subsequent modification of grain during the malting process.

A preliminary experiment identified significant differences in germination speed in a subset of varieties taken from a ~230 two-row spring barley collection, indicating there is genetic control of early stages of germination during steeping. A biparental mapping population is being used to identify additional QTLs. Six varieties were grown in 13 locations across Europe by RAGT and water uptake experiments found a significant effect of genetic background (G), environment (E) and GxE. Future work will include performing malt quality tests and using environment data gathered at each site to look for correlations with germination speed. Overall, my project seeks to elucidate our understanding of the factors impacting germination speed during steeping to better inform breeding programs.

Name of Trial: Genetic and Environmental Control of Germination speed and Malt Quality

Name of presenter: Emily Lyon

Number of plots, replicates and treatments: Mapping Population Trial – 170 lines, two replicates

Germplasm or variety: A mapping population produced by crossing two elite lines which differ in water uptake
Traits measured: Ear emergence, senescence, grain ripening, germination speed and malt quality

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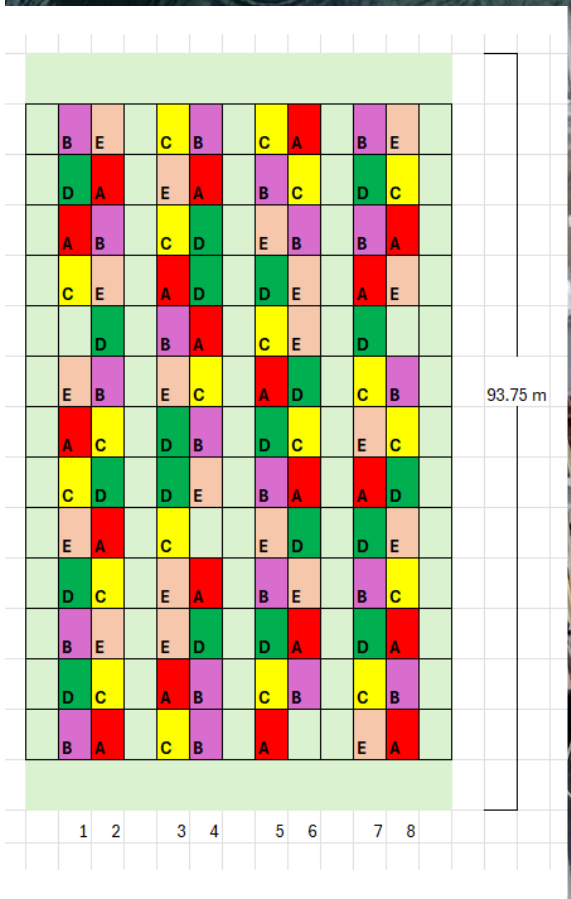
UKRI Biotechnology and Biological Sciences Research Council

R·A·G·T

Gordon McDougall - SKE-NMT: Assessing Sugar Kelp Extracts as a Nutrient Management Tool

This project is a Innovate UK-funded collaboration with Algapelago and Atlantic Mariculture who are producing energy efficient, green biostimulants from their UK cultivated kelp seaweeds. A glasshouse study showed that their kelp extracts markedly improved grain yield under reduced N-inputs. Increases of ~20% grain yield in barley at 66 % and 100 % of recommended N-application represents a substantial reduction in costs and GHG emissions.

The field trial replicates the glasshouse trial at scale and involves growing barley at 4 N-applications; 0, 33, 66 and 100% of the recommended rate. The kelp biostimulants are sprayed at two developmental stages at application rates defined by the glasshouse trials. The main outcome is grain yield and quality but the development and appearance of the plants throughout is assessed.



SKE-NMT: Assessing Sugar Kelp Extracts as a Nutrient Management Tool

Name of trial: SKE-NMT

Presenter: Gordon McDougall

The James Hutton Institute team: Tim George, Lawrie Brown, Susan Mitchell & Andrew Christie

Variety: Laureate

4 different nitrogen levels; 5 different treatments

Control; SK1, SK2, SK3 and Comparator

Ryan Douglas: Barley productivity and nitrogen losses under climate change in Scotland.

BARIToNE PhD project

Industry partner: Diageo

Academic partners: The James Hutton Institute and University of Dundee.

Spring barley is Scotland's most important crop and is a key ingredient in Scotch whisky which contributes £7.1bn/year to the UK economy. Despite relatively low nitrogen application rates, the large growing area results in substantial losses of nitrogen into aquatic ecosystems and the atmosphere. The aim of this project is to understand how fertiliser strategy affects barley productivity and nitrogen losses under current and future climatic conditions using field trial and modelling approaches. Field trials will explore how nitrogen application rate and timing impacts barley growth, yield and quality, and soil nitrogen. This data will be used to calibrate a crop simulation model which incorporates data on climate, soil and management to predict crop productivity and N losses. This will then be used to explore optimal nitrogen strategies under different climatic conditions and how climate change will impact barley production.

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James Grieves / Kirsty Binnie – Grieves House Tillage Trial: Impact of tillage and rotational position on spring barley growth, development and yield

Funding: Scottish government, AHDB, DIAGEO.

Grieves House is a mid-long-term trial site up in 2017 to evaluate the impact of tillage on soil properties. It is made of 64 strips 18m wide x 50m wide allowing most of the soil and crop management to be performed by full scale farm machinery. The trial is fully replicated (4 reps), with 16 strips in each rep. The replicates are split in half into section of 8 plots, managed as a spring or winter rotation, and half of each of these are managed under no-minimum tillage or traditional inversion plough. Inversion plough while used to produce a good seed bed for seed establishment can lead to soil erosion and therefore loss of soil function. No or minimum tillage reduces erosion but can result in lower yields particularly in spring barley. We have found however that some cultivars are not as affected by reduced tillage compared with others. Here we are trialling 15 different cultivars of barley in 3 different positions within the rotation, and in both the inversion plough and no/min tillage plots, with the aim of understanding what is driving the process of yield reduction, and what allows some cultivars to perform better under no/min tillage than others. This trial allows several regenerative agriculture practices to be combined with the testing of the impact of these on soil health, crop productivity and crop quality across a range of crops and cultivars.

Name of Trial: Grieves House Tillage Trial: Impact of tillage and rotational position on spring barley growth, development and yield

Name of presenter: James Grieves (Student) / Kirsty Binnie (Technical support)

Number of plots, replicates and treatment: Trial made up of 64 strips split into 4 replicates. Each replicate is split in half each including either a “winter” rotation (winter cropping or cover crops followed by spring cropping) or spring rotation (spring crops with soil left fallow over winter). Half of the strips are cultivated under no-tillage or minimum tillage and half are inversion ploughed. Each management plot within a replicate is made up of 8 strips (50m x 18m)
Each strip can be subdivided into 64 plots, comprising 28 guard row plots, 6 control plots and 30 test plots used for cultivar testing

Germsplasm or variety: Winter cropping: currently – Winter wheat, Cover crop (oats), spring barley, winter barley, cover crop (plots), spring beans. Spring cropping: currently – Beans, spring barley, spring oats, spring barley. Within the spring barley plots, 15 spring barley cultivars have been drilled to test their responses to tillage, and position in rotation.

Traits measured: Growth stages & plant size– emergence, tillering (cereals), stem elongation, height, time to flowering / anthesis, seed maturity.

International Barley Hub
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