Cereals in Practice

5 July 2016

Notes

Welcome to Cereals in Practice 2016

We would like to welcome you to the eighth Cereals in Practice event. We are convinced you will find much to enlighten and inform you and this will lead to improved performance in your business.

Cereals in Practice is a unique event, bringing variety trials and research together in one place to create a must-attend event for anyone interested in cereal farming and associated industries. The aim of the event is to showcase and bring together the messages arising from Scottish Government funded work on sustainable cereal production from the main research providers SRUC and James Hutton Institute.

Cereals in Practice attracts a wide range of visitors including farmers, agronomists, cereals industry representatives and scientists working with cereals.

With arable farmers coming under pressures from both home and abroad it is important the industry takes advantage of all the new technologies to remain competitive. Cereals in Practice aims to be the premier knowledge transfer event in the north of the UK combining scientific innovation with practical take home messages.

Please note that many of the demonstrations and plots on show today are research in progress.

AHDB have kindly provided input from an industry perspective as part of the Cereals in Practice organising committee, and are supportive of the event and what it is trying to achieve for Scottish growers.

Future locations

This is the fifth time the event has been held at one of SRUC's trial sites and the second one in Aberdeenshire. Continuing with the three year rotation cycle, the 2017 event will be held in Aberdeenshire once more before coming back to Dundee at one of the James Hutton Institute's Research Farms for the years 2018 to 2020.

Feedback

It would help us enormously if you would take the time to complete a feedback form today so that we can accurately assess the usefulness and success of this event. Also, you'll be entered into the SSCR Whisky Prize Draw for doing so!

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Today's Timetable

2.30pm Registration

2.45pm Welcome and briefing

From 3pm onwards, visitors are welcome to visit the plots and indoor demos at their leisure for the rest of the afternoon. There is also an option of joining a guided tour of the outdoor plots if that is your preference. Please indicate if you would prefer to join a tour when you arrive. Groups will leave the main area at approximately 3pm (tour should take around 60 minutes to complete). You can then visit the rest of the plots and/or revisit the tour stops at your own pace.

4.00pm Hog roast

7.25pm SSCR prize draw for pre-registrations and completed feedback forms

7.30pm Event closes

Event Content

Field trials and demonstrations

Below are the four groups of plots which will be included in the guided tour as well as being free to visit outwith the tour time:

- Integrated Pest Management (IPM)
    - IPM - what are the win:wins?
- Processability
    - New spring barley varieties: what attributes has breeding progress left behind?
- Nitrogen Use Efficiency (NUE)
    - Where does all the N go? Lessons from studies of NUE in cereals
- Alternative crops and cropping
    - CAP (Common Agricultural Policy) greening, N fixing crops and intercropping

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The following plots are free to visit at any time throughout the day. Some of these will be manned while others will include plot information posters only:

- Winter Wheat, Spring and Winter Barley Herbicides
- Mains of Loirston Winter Wheat Challenge
- Spring Barley variety demo
- Spring and Winter Barley Fungicide Options
- Winter Wheat Fungicide Options
- Winter Barley variety / breeding demos
- Winter Wheat variety demo
- NUE in Winter Wheat and Spring Barley
- Spot the Mutant
- InnovOat
- CAP Greening N-Fixing Crops
- CAP Greening Green Cover Crops
- Protein Crops
- Nitrogen Fixation by Faba Beans

Indoor demonstrations and exhibits

We also have a number of indoor stands and exhibits which are free to visit at any time:

- Crop Clinic: pest and pathogen identification
- How to get the most from a Drone
- A diamond in a haystack: barley leaf scald
- Blob's your Uncle
- International Barley Hub
- Food and Drink from Barley
- Farming & Water Scotland partnership project
- International Year of Pulses
- Cultivation Practices on the Metabolite Composition of Cereal Crops
- Cover Crops over winter in Scotland
- Designing a Sustainable Cropping System?

The James Hutton Institute

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The James Hutton Institute is a world-leading scientific organisation encompassing a distinctive range of integrated strengths in land, crop, waters, environmental and socio-economic science. It undertakes research for customers including the Scottish and UK Governments, the EU and other organisations worldwide. The institute has a staff of nearly 500 and 150 PhD students operating over two main campuses, Aberdeen and Dundee, and four research farms; Glensaugh, Balruddery, Mylnefield and Hartwood. We work collaboratively and in partnership with a number of Scottish and overseas universities.

The Institute organises its research through six principal themes: Safeguarding Natural Capital; Enhancing Crop Productivity and Utilisation; Delivering Sustainable Production Systems; Controlling Weeds, Pests and Diseases; Managing Catchments and Coasts; and Nurturing Vibrant and Low Carbon Communities.

The James Hutton Institute operates a commercial subsidiary, James Hutton Limited (JHL), which commercialises the scientific expertise, intellectual property, facilities and resources of the Institute. JHL offer commercial customers a comprehensive range of analytical, research and development, breeding, and consultancy services. JHL was formed through a merger of Mylnefield Research Services Ltd and Macaulay Scientific Consulting Ltd, former commercial subsidiaries of the Institute.

The Institute takes its name from the 18th century Scottish Enlightenment scientist, James Hutton, who is widely regarded as the founder of modern geology and who was also an experimental farmer and agronomist.

The James Hutton Institute

Cereals in Practice

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Scotland's Rural College (SRUC)

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Scotland's Rural College (SRUC) supports innovation and sustainable development in agriculture and the rural sector in Britain and internationally. We are one of the UK's leading agriculturally-focused higher education institutions, offering a unique blend of research, education and consultancy. We work collaboratively and in partnership with several research and higher education institutes in the UK and in 2014, agricultural and veterinary research at SRUC and the University of Edinburgh was ranked as most powerful in the UK in the Research Excellence Framework (REF) results.

SRUC's research and education activities operate from six campuses and eight farms and research centres across Scotland. Our consultancy arm, SAC Consulting, supports more than 12,000 farms and rural businesses across the UK from 25 consultancy offices and eight veterinary disease surveillance centres.

Our Crop & Soil Systems research group carries out research to underpin the development of resilient and sustainable systems of crop production that are economically viable, but also environmentally and socially acceptable. Soils are the fundamental base of all future production, hence our interest in rotations, organic matter and nutrient cycling. Our work in crop genetics and breeding considers not only increasing yields of some of our key crops, but also assesses new ways to protect the health of our plants. Managing pests and diseases makes farming more efficient and sustainable, so that more food can be produced on smaller areas of land.

As a Further and Higher Education institution we offer land-based courses at all levels – from access courses and vocational studies, through undergraduate programmes covering HNC, HND and undergraduate degree courses, to taught postgraduate programmes and PhDs. Within six months of completing their course, 95% of our graduates are in work or are continuing in full-time education.

SAC Consulting offers a wealth of local knowledge and expertise covering all aspects of rural enterprise; from agronomy, livestock and dairy services to disease surveillance, farm animal diagnostics and environmental consultancy. Our own dedicated UKAS-accredited analytical facilities provide a seamless service from field to lab.

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Cereals in Practice

SRUC

Scottish Society for Crop Research (SSCR)

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As the Society moves closer to its 100th birthday, one of its principal roles, that of knowledge transfer from research to practical farming, processing and consumption, has never been more important. This was a major obligation placed on the Society at the time of its establishment to run the Scottish Plant Breeding Station early in the 20th century and has certainly not been diminished over the intervening years.

However, more and more of those investigating fundamental problems in agriculture, horticulture and arboriculture are required to demonstrate value for the investment. One of the most effective ways of showing this is through events such as Cereals in Practice, Potatoes in Practice and Fruit for the Future, in which both the Society and the James Hutton Institute, with which it is closely linked, play a major role in organising. The success of such events can best be measured by the steady increase in the numbers attending, especially over the past five years.

The involvement of other organisations, including SRUC and commercial companies, and the opportunity to also demonstrate practical products such as machinery, chemicals and composts, has added greatly to the value of these events. This has also been matched by an increase in the Society's membership which is higher than it has ever been. There are few other events, even today, where those attending can see such a range of science, from very fundamental studies on genotypes, through to the best methods for growing crops to achieve maximum output and quality.

If one adds to this the Society's support for new areas of research, and assistance to young scientists seeking to build their career, the overall package of the Society's activities is one in which the Society's forebears at the time of its foundation back in 1921, would have taken great satisfaction.

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Cereals in Practice

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Integrated Pest Management (IPM)

Fiona Burnett and Neil Havis, SRUC

Adrian Newton, James Hutton Institute

Key Principles

- Are there immediate win:wins with IPM in Scotland?
- Look at the impact of variety and tailored pesticide programmes on disease pressure at the site
- New alternatives to pesticides might be developed
- IPM has to be tailored to your site – what have you adopted and what might you do in the future?
- We are losing tools – hear the latest on pesticides at risk and resistance management

Key Recommendations

- Make an IPM plan for your farm
- Use the new planning tool for Scotland: http://bit.ly/pestmanagementplan
- Identify your key pest, weed and disease risks
- Where possible select varieties that reduce these risks
- Plan agronomy to minimise the main risks
- Monitor crops and tailor pesticides to the in-season issues

Economic Benefits

- More targeted pesticide use and reduced pesticide bills
- Lower pest, weed and disease pressure and increased yield
- Reduced risk of resistance development
- A wider choice of resistant varieties as demand for them grows
- More resilient crop systems

Environmental Benefits

- Reductions in artificial inputs
- Greater biodiversity
- Better water quality
- Reduction in pesticide contamination issues

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Cereals in Practice

SRUC

Improving Malting Barley

Bill Thomas, James Hutton Institute

Steve Hoad, SRUC

Key Principles

- Breeding has improved the genetic potential of yield and malting quality characters in spring and winter recommended barley varieties
- Newer varieties tend to show higher levels of grain skinning than older ones. DNA markers for grain skinning could aid selection of varieties that combine skinning resistance with high malting quality
- The processability of malting barley varies by variety and DNA markers could also be used to select for lines that process well under a wide range of grain nitrogen conditions.

Abstract

There is still considerable genetic variation amongst spring and winter barley varieties on the current AHDB Cereals & Oilseeds recommended lists. Combining DNA fingerprints of these and other advance varieties highlights chromosomal segments that are important in the control of key characters and are particularly useful when characters are difficult to measure, e.g. grain skinning and malt processability. We are collaborating on projects to share data that can be used to identify specific DNA markers that could be used by breeders, testing authorities, and end-users to identify new varieties that are more resistant to grain skinning or can malt well over a range of grain nitrogens, the latter aspect potentially improving the marketability of malting barley.

Genetic analysis has also shown that current winter malting barley varieties lack some of the key malting quality genetic segments found in current spring types. We have worked with major breeding companies to pinpoint these regions with molecular markers, which the breeders are then using to select lines that combine winter habit with spring quality from crosses between winter and spring barley lines.

Economic Benefits

- High yield and good malting quality leads to more barrels per hectare

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The James Hutton Institute

Cereals in Practice

SRUC

Where does all the N go?

Bill Thomas & Luke Ramsay, James Hutton Institute

Ian Bingham, SRUC

Key Principles

- Trialling a range of different wheat varieties under different nitrogen inputs coupled with plant analysis reveals the fate of applied fertiliser in the plant
- Coupling this data with DNA fingerprints of each variety can identify specific chromosomal regions associated with aspects of Nitrogen utilisation
- Recent advances in genome analysis mean that we now have a near complete assembly of barley that can be used to identify candidate genes in nitrogen metabolism
- Selection of alternative alleles at such loci could improve nitrogen utilisation

Abstract

We have grown over 150 wheat varieties that represent several decades of wheat breeding in Europe under three different nitrogen regimes. Results clearly show an absence of a marked variety x fertiliser level interaction, which means that selection of the best lines under high input conditions is equally valid for low input conditions.

Because all the lines trialled have a known date of introduction, we can use regression analysis to determine if there has been any improvement in aspects of nitrogen use efficiency over time. This shows that nitrogen uptake efficiency hasn't changed over time but utilisation efficiency (the amount of N taken up by the plant that results in grain yield) has significantly improved. This is largely due to increases in harvest index. Older varieties, e.g. Capelle Desprez, have low harvest indices whereas modern ones, e.g. KWS Santiago, have high ones.

Variation at some genes known to affect nitrogen metabolism (e.g. glutamine synthetases) appears to be co-located with regions affecting aspects of nitrogen utilisation efficiency.

Economic Benefits & Prospects

- No need to set up breeding programmes specifically for low nitrogen input agriculture
- Knowledge of potential candidate genes affecting nitrogen utilisation can be used to identify variants that may improve the character
- A wider range of varieties needs to be examined to identify suitable variation for further improvements in NUE
- Detailed understanding of nitrogen metabolism in the field will also help identify suitable targets for agronomy and breeding

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Cereals in Practice

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Cereal-legume plant teams

Adrian Newton and Pete Iannetta, James Hutton Institute

John Baddeley and Robin Walker, SRUC

Key Principles

- Cereals require fertiliser nitrogen (N) to yield well, legumes can acquire all their N from air
- Growing cereals and legumes together (intercropping) reduces cereal fertiliser N requirement
- Their complementary behaviour allows biomass production to exceed that of monocrops
- Intercropping can also suppress weeds and disease
- High legume post-harvest residues left in-field allow N fertiliser reductions for following crop

Key Recommendations

- Harvested as "whole crop" – yield is excellent for feed, silage or energy generation (via AD, or Anaerobic Digestion)
- Suitable combinations may be harvested as grain
- The balance of each crop-type can be altered to match end use requirements
- Legume performance and yield can be enhanced by the non-legume
- Higher levels of soil phosphorous can be mobilised

Economic Benefits

- Reduced inputs of nutrients (N & P) enhance resource use efficiency
- Reduced inputs in general save costs (fertiliser, herbicide, pesticides fuel)
- More reliable production with suitable mixtures for whole-crop
- Yield benefits for following (non-legume) crop in the rotation
- Yield qualities for higher premium markets can be facilitated

Environmental Benefits

- Reduced toxic pesticide
- Reduced diffuse pollution from lower fertiliser inputs
- Natural chemical cycling enhanced
- Soil mineralisation slower with higher legume residue inclusion

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Cereals in Practice

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Nitrogen Fixation by Faba Beans

Euan James and Pete Iannetta, James Hutton Institute

Key Principles

- Faba beans provide highly nutritious grains that are rich in starch, protein and essential minerals
- Faba beans meet their entire nitrogen (N) requirement by using N "fixed" from air
- This process is called Biological Nitrogen Fixation (BNF) and occurs via a symbiosis between beans and soil bacteria called *Rhizobia,* of which there are several different types
- Faba beans also benefit other crops in the rotation, as well as soil and pollinating insects

Key Recommendations

- Faba beans at the Centre for Sustainable Cropping (CSC) acquired at least 90% of their nitrogen from air
- The faba beans grown in the "Sustainable" fields at the CSC had 5-10% higher BNF than those in the "Conventional" fields
- Higher BNF under the "Sustainable" regime may be due to better soil qualities improving root growth
- The addition of compost to help increase soil organic matter content has helped
- The rhizobia at the CSC are high functioning and have been isolated

Economic Benefits

- Faba beans are important foodstuffs for animals and are also high value human foods
- Increasingly, faba beans are also used to make aquaculture feeds
- The supply of faba beans for aquaculture is secured at a value above wheat prices
- Financial savings from reduced inorganic N fertiliser applications are considerable
- These include N fertiliser avoided and offset due to high N residues left in field after harvest

Environmental Benefits

- Growing legumes lowers N fertiliser use and provides large reduction in carbon footprints
- Other potent greenhouse gases, such as nitrous oxide (N_2O) from fertilisers are also reduced
- Soil mineralisation (breakdown) is lowered by high levels of legume residues
- The deep tap roots of faba beans deliver benefits throughout the soil profile
- Faba beans provide rewards to pollinator and bumble bees in particular help increase yields

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Cereals in Practice

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CAP Greening Nitrogen-Fixing Crops

John Baddeley, Robin Walker and Lorna Cole, SRUC

Key Principles

- Ecological Focus Areas are part of the Basic Payments Scheme and aim to increase biodiversity
- Nitrogen-fixing crops (legumes) also increase the amount of N in the soil for following crops
- Permitted crops are: alfalfa, beans, birdsfoot trefoil, chickpea, clover, lentil, lupin, peas, vetch
- Currently, at least two crops from the list must be grown separately, not as a mixture
- Harvest not allowed before 1 August

Demonstrated crops

- Demonstrated straight crops are: alfalfa, beans, black medic, 3 clovers, lupin, peas, vetch
- We also have five, 3-species mixtures as these can be more productive (currently not allowed under CAP greening rules)
- Trials at Aberdeen and Edinburgh are examining agronomic, environmental and economic performance
- Results will be presented at various KE events and in publications as they become available

Economic Benefits

- Growing a legume reduces the amount of N fertiliser needed for the following crop
- Forage legumes provide a protein-rich feed for stock
- Grain legumes can be harvested when ripe or used as part of wholecrop silage

Environmental Benefits

- Increased soil organic matter and biological activity, improved soil structure
- Reduced leaching losses, suppression of weeds and reduced pest and disease problems
- Growing two or more different legumes can extend the flowering period for pollinators
- Increased on-farm production of protein

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These trials are funded by the Mains of Loirston Trust and Scottish Government RESAS

The James Hutton Institute

Cereals in Practice

SRUC

CAP Greening Green Cover Crops

John Baddeley, Robin Walker and Lorna Cole, SRUC

Key Principles

- Ecological Focus Areas are part of the Basic Payments Scheme and aim to increase biodiversity
- Permitted green cover crops are: alfalfa, barley, clover, mustard, oats, phacelia, radish, rye, triticale, vetch
- Currently, at least two crops from the list must be grown as a mixture
- Crops must be established between 1 March and 1 October and maintained until 31 December
- They cannot be used to support any agricultural production directly (e.g. grazing, harvest)

Demonstrated crops

- Autumn 2015 sown mixtures of different proportions of winter vetch with either rye or a cereal mixture
- Spring 2016 sown mixtures of non-legumes (*Phacelia*, mustard, black oats) with legumes (alfalfa, red clover, vetch)
- Trials at Aberdeen and Edinburgh are examining agronomic, environmental and economic performance
- Results will be presented at various KE events and in publications as they become available

Economic Benefits

- Growing a green cover crop may increase the yield of a following crop
- Growing a mixture that includes a legume reduces the amount of N fertiliser needed for the following crop

Environmental Benefits

- Increased soil organic matter and biological activity, improved soil structure
- Potential suppression of weeds and reduced pest and disease problems
- Extended flowering period for pollinators and improved wildlife habitat
- Overwinter cover crops help reduce leaching losses of N and limit soil erosion and P losses
- Green cover crop mixtures that contain a legume add biologically fixed N to the soil

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Protein Crops

Robin Walker and John Baddeley, SRUC

Key Principles

- There are UK and EU government concerns about the perceived protein gap
- This trial investigates a range of home grown protein crops as an alternative to imported soya
- Protein crops are usually legumes and hence use biological N fixation in symbiosis with *Rhizobia* on their roots, so have no need for N fertiliser applications (they might need inoculum though)
- A number of protein crops are eligible under the CAP greening rules, but not all, and currently not in mixtures

Demonstrated crops

- Sole crops: Soya varieties (x4), field beans, lupins, peas
- Mixtures: Lentil varieties (x2) intercropped with spring oats, and field beans, lupins and peas each intercropped with spring barley
- Soya and lentil varieties used have been grown successfully in Sweden and Northern Germany
- The trial is examining agronomic, environmental and economic performance of the crops
- As results become available, they will be presented at various KE events and in publications

Economic Benefits

- A useful option as a break crop which can improve yields of following crops
- Growing a legume reduces the N fertiliser requirement for both the current and following crop
- Grain legumes grown as a sole crop or as part of an intercrop can provide a protein-rich feed for stock, with less reliance on imported feed
- Grain legumes can be harvested when mature or used as part of wholecrop silage

Environmental Benefits

- Increased soil organic matter, improved soil structure and increased biological activity
- Reduced N leaching losses, reduced pest and disease problems
- Increased on-farm production of protein with potential to reduce carbon footprint associated with imports

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These trials are funded by the Scottish Government RESAS

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Cereals in Practice

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Improving oat varieties and agronomy

Bill Thomas, James Hutton Institute & Sandy Cowan, IBERS

Key Principles

- The demand for oats has increased and the crop can be an attractive alternative to wheat and barley
- Crop growth guides have been developed for barley and wheat to help growers improve growing of these crops but a comparable guide does not exist for oats
- There is a big gap between potential yield and the average yield of oats that a growth guide should help to narrow
- Targeted breeding is producing improved varieties for growers

Abstract

Developing a crop growth guide requires sampling growing crops during the growing season over a range of sites and years so that the key stages where growers can adjust their management regimes to maximise their outputs can be identified. The adoption of unmanned aerial vehicles (UAVs) has been a major development since the publication of the barley and wheat growth guides and is expected to improve the assessment and interpretation of crop growth. Innovate UK has funded a project led by Pepsico with inputs from James Hutton Institute, NIAB, ADAS, IBERS, and Environmental Systems to conduct crop growth analysis at a number of sites across the UK for harvest years 2015-18 inclusive and combine the results from spectral imaging of the sampled areas obtained by UAVs. The various crop phenotypes so obtained will then be used to develop an interactive crop growth model that can be used by growers to modify inputs during the growing season in the most profitable manner.

IBERS breeding objectives: to produce high yielding oats which have improved disease resistance, improved lodging resistance and with the desired grain quality characteristics which meet the diverse end-users requirements

Economic Benefits

- A better understanding of oat growth and the development of yield within the canopy will improve growers' profitability

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InnovOat

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Developing enhanced breeding methodologies for oats for human health and nutrition

InnovOat is a five year (September 2014 - September 2019) project funded through the BBSRC LINK scheme. It is led by Aberystwyth University with partners NIAB, Heriot Watt University, Senova and the BOBMA research group. The aims are to use modern breeding technologies to capture and enhance the proven health benefits of oats in new oat varieties.

The project will develop and apply state-of-the-art genomic and metabolomic tools for oat genetic improvement. Its primary focus is on the understanding and manipulation of key traits that will enhance the value of oats in human health improvement. It will develop new varieties which will enhance health benefits whilst capitalising on the value of oats as a low input cereal, and increase the environmental and economic sustainability of cereal based rotations.

It comprises six work packages (WP). The first three WP are developing the powerful enabling technologies dealing with genetics, genomics and their application to different breeding schemes. This also includes the development of specific populations to test these methods and provide accurate phenotypic data. WP4 includes the metabolite characterisation of various components of oat grains and their relevance to human health and nutrition. WP5 integrates the previous work packages into the breeding programmes and WP6 deals with dissemination of the results.

This multi-disciplinary programme which combines modern genetic and phenotypic methodologies with the expertise of oat breeders and end-users, will also address long term breeding goals by developing experimental populations which are polymorphic for agronomically important traits but more amenable to mapping and forward genetic approaches than conventional agronomic lines.

Here we are demonstrating some contemporary winter and spring oat varieties from the IBERS breeding programme.

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Spot the Mutant

Robbie Waugh and Bill Thomas, James Hutton Institute

Key Principles

- Mutation is the driving force behind the differences between individuals in a population and occurs at a random rate of approximately 1 in 10^9
- Chemicals and/or ionising radiation can accelerate the rate of mutation and are especially useful in identifying novel variants
- Mutation has been used to produce semi-dwarf plants so that all current UK recommended spring barley varieties have a semi-dwarf allele that was the result of radiation breeding
- Radiation breeding was also successfully used to produce Golden Promise

Abstract

Previously, mutation breeding relied upon phenotypic screening to identify novel variants but many mutants, some of which may well have been beneficial, remained undetected in the absence of a suitable phenotypic screen. Now that we have quite a comprehensive set of barley sequence data, we can explore mutant populations for sequence variants for any gene for which we have a coding sequence. We can then isolate plants that have such variations, predict possible phenotypes from observations made in other species and then design a suitable phenotypic test to determine if any of the variants have any beneficial effects upon characters of interest.

Our demonstration plot is a population of Golden Promise that has been treated with a chemical mutagen that should introduce changes at single base sites in a DNA sequence. The normal phenotype is short-strawed, two-row ear, short awns (less than the length of the ear), waxy bloom on all plant organs, and a medium-dense ear. Can you see any differences in the plot? Do any look potentially useful to you?

Economic Benefits

- High yield and good malting quality leads to more barrels per hectare

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Cereals in Practice

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Winter Wheat and Barley Herbicides

Martin Richards, SRUC

Key Principles

- Weed control in winter cereals is important due to the increasing threat of grass weeds
- Attention to detail is needed to prevent a weed problem developing
- Most autumn residuals control annual meadow-grass and some broad-leaved weeds
- Some also control more difficult weeds such as brome species and blackgrass
- Autumn residuals are particularly important in winter barley because post-emergence options are more limited than in wheat
- However winter barley has an advantage in that it tends to be better at supressing weeds than wheat

Demonstrated herbicides

- Pendimethalin – a pre-emergence herbicide that controls grass and broad-leaved weeds
- Flufenacet – for control of blackgrass, annual meadow-grass and some broad-leaved weeds
- Prosulfocarb – generally in mixtures to control some grasses and broad-leaved weeds
- Diflufenican – gives residual control of a wide range of broad-leaved weeds
- Chlortoluron – for grasses and some broad-leaved weeds. Only in products Tower and Tribal
- Picolinafen – for chickweed and some other broad-leaved weeds
- BAS 758H – novel new herbicide

Economic Benefits

- There is nearly always an economic response to weed control in winter cereals
- There can be a large response if competitive species such as cleavers, scentless mayweed, wild oats, brome and blackgrass are present
- Residual herbicides tend to give the largest response

Environmental Benefits

- Herbicides offer efficient weed control, and can have less impact than alternative methods
- Care is needed to protect watercourses from autumn-applied herbicides
- Buffer zones and grass margins help to prevent residual herbicides entering water

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Mains of Loirston Winter Wheat Challenge

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The Mains of Loirston Winter Wheat Challenge is a competition where the farmers and advisers of the future pit their wits against each other to achieve the crop with the highest gross margin. Teams from SRUC's campuses at Aberdeen, Edinburgh, Oatridge and Barony are represented. The field trials team at SRUC grow field plots under instruction from the teams. Decisions that have to be made include: variety, seed rate, fertiliser, and disease and weed control. Trials are replicated at three sites, including Fife, Edinburgh and here at Cereals in Practice.

At harvest each plot is yielded and WN Lindsay's then offer a price for the crop based on its quality.

Last year's winner, from Edinburgh, successfully grew a crop of Viscount, using reduced rates of fungicides and moderate fertiliser. Who will win this year's challenge?

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International Barley Hub

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Creating the world's leading centre translating excellence in barley research and innovation into economic, social and environmental benefits

Barley is indispensable to the UK economy, being vital to the distilling, brewing, and food industries as well as having potential for a host of emerging uses in the health, chemicals and energy sectors. The opportunity for an International Barley Hub, a centre of excellence, to be located in Scotland is an exciting one and must be grasped to ensure the sustainability of our world leading agricultural, distilling and brewing sectors.

A partnership between the James Hutton Institute and the University of Dundee - working with key industrial sectors - is turning this opportunity into a reality.

At a time of increasing uncertainty around barley supply due to the implications of climate change, increasing worldwide demand, evolving pest and disease risks and agronomic pressures, it is vital that the UK has access to a vibrant barley research community as proposed within the International Barley Hub. Sustainability is at the heart of everything we do and if this can be linked to innovation this will ensure the long term development of the barley value chain as a whole.

The Hub will comprise a new bespoke technical facility with the flexibility to adapt to future requirements, and a unique array of specialist equipment and testscale processing installations. Accommodating over 100 Institute, industry and visiting research staff the Hub will be located at our Invergowrie campus, near Dundee. The benefits of co-locating staff from related disciplines and sectors are well-established: cross-fertilisation of ideas, synergies in the innovation process and faster development times. This is a key benefit of the International Barley Hub. SMEs and large companies will gain flexible access to unique facilities, expertise and collaborative research opportunities unavailable elsewhere or prohibitively expensive if undertaken in isolation.

In addition, the Hub will provide tailored training for industry, farmers and researchers and will be a portal for information and knowledge exchange.

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International Year of Pulses

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Pulses - the Perfect Crop?

Pulses are the dried seeds of a small number of crop plants in the legume family, including peas, beans and lentils. Pulses are an important source of plant-based protein, and eating them can combat health problems linked to poor diet.

Bacteria inside the roots of pulses turn nitrogen gas within the atmosphere into valuable plant food that also benefits other crops, providing a sustainable alternative to artificial fertiliser.

Pulses are multifunctional. Because they have no requirement for man-made nitrogen fertilisers, pulses present a sustainable form of protein production. They deliver highly nutritious food with a long shelf-life and are rich in healthy starches, protein and essential minerals. Cultivating pulses promotes natural nutrient cycling, provides resources to beneficial insects and pollinators, safeguards soil quality and increases the efficiency of crop rotations.

Pulses are being used to manufacture high value products using processes which generate no waste.

The James Hutton Institute is applying the latest research tools to maximise the benefits pulses can deliver for Scotland's economy and environment.

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Blob's Your Uncle

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Visualising Cereal Pedigrees with Helium

Ensuring food security in a world with an increasing population and demand on natural resources is becoming ever more pertinent. Plant breeders are using a large and diverse range of data types to identify plant lines with desirable characteristics suitable to be taken forward in plant breeding programmes. These characteristics include key morphological and physiological traits, such as disease resistance and yield that need to be both maintained and improved upon if a variety is to be commercially successful.

The ability to predict and understand the inheritance of alleles that facilitate resistance to pathogens or other important characteristics is crucial, however, derivation of the inheritance of such traits by traditional molecular techniques is expensive and time consuming. Computational tools that provide the ability to visualize diverse data types in a pedigree context will enable breeders to make more informed decisions.

Traditional family tree style layouts are commonly used and easily understood but are unsuitable for the data densities that are now commonplace. The size and complexity of plant pedigrees means that there is a cognitive limitation in conceptualising large plant pedigree structures, therefore novel techniques and tools are required by geneticists and plant breeders to improve pedigree comprehension.

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Comparing the Effects of Different Cultivation Practices on the Metabolite Composition of Cereal Crops

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We are investigating of the comparative effects of conventional vs sustainable agricultural practices on the chemical, physical and agronomic properties of crop species of major economic importance in Scotland, including spring barley, winter barley and winter wheat. The composition of metabolites can impact upon flavour, texture and nutritional value.

Metabolite composition of the cereals under investigation was determined using broad-brush metabolite profiling for simultaneous analysis of many metabolites. Freeze-dried powdered samples were extracted using a multi-phase solvent system to give separate extracts containing polar and non-polar metabolites. After concentration and isolation each extract was analysed by gas chromatography-mass spectrometry (GC-MS). Metabolite distribution profiles for each sample were generated and analysed using various statistical methods. Preliminary data analysis suggests that inter-varietal variation in composition and year to year variation may be more significant than the effects of cultivation (input).

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Cover Crops over Winter in Scotland

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Over winter 2015/16 we used a replicated block experiment to trial a cover crops and a stubble retained control at Balruddery farm. Our measurements focussed on soil properties under Jupiter turnip rape, Defender oil radish and the Vitality mix of five species. Soil was wetter under the cover crops at 10 and 20 cm depth but not at deeper depths. Despite being wetter the surface soil had greater shear strength under the cover crops than the stubble control suggesting better resistance to erosion.

FTIR (Fourier Transform Infrared Spectroscopy) analysis indicated more soil organic matter with some evidence for slightly higher protein under the vitality mix than under the control. By improving shear strength in the surface soil cover crops help protect the soil from erosion. Increased concentrations of soil organic matter contributes to improvements in many soil functions. The impact on the subsequent spring barley crop is yet to be determined.

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A diamond in a haystack: looking for new sources of varietal resistance to barley leaf scald

Max Coulter, James Hutton Institute

Key Principles

- Leaf scald is one of the most destructive diseases of barley, particularly in cool wet climates
- New EU restrictions on fungicides will increase the importance of varietal resistance in controlling the disease
- Certain genes present in the genome, known as “Resistance genes” can give resistance to leaf scald
- Identifying these genes will allow us to better understand how barley fights infection, and will provide a resource for breeders to breed new varieties with effective resistance

Economic Benefits

- Leaf scald can cause yield losses of 20 – 40%
- Leaf scald in 2005 caused an estimated yield loss worth £7.2 million in the UK
- Incorporating varietal resistance will increase yields, and grain quality without the use of fungicides

Environmental Benefits

- Incorporation of varietal resistance will mean a reduction in infection without the use of fungicides

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Crop Clinic

Andy Evans and Fiona Burnett, SRUC

Key Principles

- Accurate diagnosis of problems is a key part of successful management
- Pest, weed and disease ID examples on display
- Pre-planning and testing of soils can help in planning rotations
- Experts available on the day
- Look at the good, the bad and the ugly bugs in glorious close up using our microscopes

Key Recommendations

- Test soils for pests and pathogens like clubroot and nematodes
- Access crop advice and updates to keep in touch with emerging issues
- Test your own ID skills
- Discuss your particular issues with the clinic staff there on the day
- Ask for advice on best control methods

Economic Benefits

- Targeted solutions to problems
- Positive feature in IPM plans
- Reduced pesticide bills
- Better crop yields

Environmental Benefits

- Reductions in artificial inputs
- Reduction in pesticide contamination issues

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How to get the most from a Drone?

Simon Gibson-Poole, SRUC

Key Principles

- Drones are becoming increasingly popular and are getting much easier to use. As more advanced sensors and better ways of processing the information they can collect become more commonplace, they will no doubt become an essential part of the agricultural toolbox.
- If you own your own drone already, what can you do to get the most out of it?

Key Recommendations

- Follow the Civil Aviation Authorities 'Drone Code' to make sure you fly safely and within the law and get basic drone insurance to protect you if something does go wrong.
- Make use of online services to create orthmosaic maps of all of your fields, as this will enable you to keep a history of the changes seen in your fields over time.
- To get more out of your imagery, make use of free Geographical Information System software, so that you can measure and effectively locate problem areas within fields or calculate vegetation indices to help identify crop performance.

Economic Benefits

- Being able to see your fields from the air and without have to walk through the crop will enable you make more informed management decisions about fertilizer or irrigation rates, which could improve yield or reduce input costs.
- Aerial videos and imagery can be very useful material to help promote your business, as a way of showing how your farm operates and that you are using the latest technology.

Environmental Benefits

- If drone imagery helps to decrease fertilizer or pesticide inputs to your fields then the environment will benefit as a results of this.

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Designing a Sustainable Cropping System?

Cathy Hawes and Gillian Banks, James Hutton Institute

Key Principles

- For arable farming to be sustainable in the long term, it needs to be financially viable whilst maintaining high levels of biodiversity and soil, water and air quality
- At the Centre for Sustainable Cropping we are designing a sustainable cropping system to optimise the economic, environmental and ecological components of arable production
- Best management options are combined into a single cropping system to assess overall long-term costs and benefits
- 'Success' of the sustainable system is judged over the course of a six year rotation by comparison to conventional practice

Key Recommendations

- Reduce inputs whilst maintaining yield using an integrated farming approach that:
  - Minimises loss of soil, water and nutrients from the system
  - Increases resource use efficiency by crop plants
  - Replaces agrochemical inputs and mineral fertiliser with alternative sources (e.g. BNF) and management (e.g. IPM)

Economic Benefits

- Potentially lower input costs
- Cost-benefit analysis on the CSC after a full six year rotation will indicate the likely impact on financial margins, balancing inputs against yield and sale prices

Environmental Benefits

- Enhanced biodiversity for ecosystem services (nutrient cycling, natural enemy control of crop pests, pollination)
- Reduced losses of inputs to water, soil and air resulting in reduced pollution and lower requirement for agrochemical inputs to maintain the system in the long term

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	www.abdn.ac.uk/rowett/policy-industry/oat-barley-cookbook-805.php	

Food and Drink from Barley

Barley is a source of β-glucan, which has been shown to reduce blood cholesterol if more than 3g per day is consumed. Scottish Government funded research at the Rowett Institute of Nutrition and Health is investigating the benefits of eating barley. Come along and taste some barley-based foods and discover recipes to help increase barley intake in your everyday diet.

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Farming & Water Scotland

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Farming & Water Scotland aims to raise awareness of the diffuse pollution General Binding Rules (GBRs) and to discuss with land managers some practical ideas on how they can reduce pollution risk, comply with regulations and benefit the farm business.

As well as providing information, the stand will house demonstration equipment such as video displays, buffer strip, soils and biobed models.

Funded by Scottish Government, staff from Scotland's Rural College (SRUC) and SEPA will be on hand to answer questions and provide practical advice.

Complying with the diffuse pollution general binding rules and following good practice, can help improve Scotland's water environment, protect those whose livelihood may depend on good water quality and can benefit your farm business.

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Science and Advice for Scottish Agriculture (SASA)

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Science and Advice for Scottish Agriculture (SASA), part of the Scottish Government's Agriculture, Food and Rural Communities Directorate is the Certifying Authority for seed production in Scotland. The Official Seed Testing Station (OSTS), SASA, is responsible for testing of all certified seed in Scotland through supervision of Licensed Seed Testing Stations and provision of a testing service to Government and the seed trade. Testing is also conducted for advisory purposes allowing industry to make informed decisions on their seed stocks. Supporting this testing is a research and development programme investigating emerging industry concerns, development of test methods and health surveys of cereal seed in Scotland.

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