SSCR
Scottish Society for Crop Research

Programme and Abstracts

SSCR Potato Committee

Winter Meeting

24 March 2014 13.00 to 16.30

The James Hutton Institute, Dundee DD2 5DA

Vales Sovereign

Gemson

SSCR Potato Committee – Winter Meeting

24 March 2014, 13.00 to 16.30
NEW SEMINAR ROOM, THE JAMES HUTTON INSTITUTE, DUNDEE

13.00-13.30	*Registration and coffee*
13.30	**Welcome and Introduction**
13.35	**The influence of drought and arbuscular mycorrhizal fungi in cultivated potato** Ankush Prashar and Alison Bennett, The James Hutton Institute
13.50	**Evaluation of performance of sediment fence for erosion control** Andy Vinten, The James Hutton Institute
14.05	***Sitobion avenae* - the grain aphid: is it a new vector threat to your potato crop?** Brian Fenton and Gaynor Malloch, The James Hutton Institute
14.25	**Molecular marker development and application to potato breeding programmes** V Young, K McLean, MFB Dale, G Bryan, C Hornyik and A Prashar, The James Hutton Institute
14.45	**Towards the identification of genes for tuber shape formation and eye depth development** Csaba Hornyik, The James Hutton Institute
15.00	**R&D into blackleg caused by *Pectobacterium atrosepticum*: an update** Ian Toth, The James Hutton Institute
15.25	**Controlling potato blackleg: The Scottish and UK approach** Gerry Sadler, SASA
15.50	**The New EU seed potato classification scheme: options for Scottish Implementation** John Kerr, SASA
16.15	**Discussion and Closing remarks**
16.30	*Close of meeting*

Finlay Dale
Secretary, SSCR Potato Committee
The James Hutton Institute
Dundee DD2 5DA
Tel: 01382 568740
Email: Finlay.Dale@hutton.ac.uk

Sharon Neilson
Events Co-ordinator
The James Hutton Institute
Dundee DD2 5DA
Tel: 01382 568750
Email: events@hutton.ac.uk

The influence of drought and arbuscular mycorrhizal fungi in cultivated potato

Ankush Prashar and Alison Bennett
James Hutton Institute, Invergowrie, Dundee DD2 5DA

Global climate change is predicted to increase the frequency and severity of drought events so crop breeding for increased drought tolerance and water use efficiency is an urgent priority to ensure more reliable yields under conditions of water limitation. Conventional plant breeding programmers have overlooked, and may have inadvertently selected against, crop varieties that form symbiotic associations with arbuscular mycorrhizal (AM) fungi. AM fungi are plant mutualists which uptake nutrients for host plants and have been shown to increase drought tolerance in multiple crop species, including potato.

Plants selected for high water use efficiency have reduced rates of transpiration but can then suffer reduced rates of nutrient uptake, which is partly driven by mass-flow. Arbuscular mycorrhizal (AM) fungi can simultaneously improve plant water use efficiency and nutrient uptake. Potato is one of the UK's most water demanding crops and often requires artificial irrigation to ensure good yields. However, there is little information on potato genetic variation in mycorrhiza-forming abilities, and there is an urgent need to improve potato drought tolerance and nutrient use efficiency in agricultural environments.

This project addressed two questions: First, is there variation in AM fungal colonization potato genotypes, and is this influenced by drought? Second, is there variation in potato response to the presence of AM fungi, and, if so, is this variation dependent upon genotype and/or altered under drought conditions?

To address these questions we grew 15 varieties of cultivated potato in live soil (containing AM fungi) and sterile soil (lacking AM fungi), and examined plant biomass and yield, AM fungal colonisation of roots, and water and nutrient use efficiency. We are still collecting data, however our preliminary results show that AM fungal colonization varies with potato genotype, and that drought reduces AM fungal colonization. In addition, there are strong genotypic influences on plant mass and tuber yield, and these are altered by the presence of a soil community. In addition, both the soil community and drought alter potato resource allocation to roots. We are still analysing plant physiological measurements (particularly photosynthesis, stomatal conductance, and Δ13C (WUE)) determine whether AM fungi influence these characteristics in droughted and watered plants and whether this depends on plant genotype. In addition, we are also completing data collection of transcriptomic analyses of one potato cultivar (Desiree) grown with and without AM fungi and subjected to drought.

Our answers to the questions above will help us utilize AM fungi to improve drought tolerance in potato fields.

Evaluation of performance of sediment fence for erosion control at Wester Gospetry farm, Fife.

Andy Vinten , Andrew Cuthbert, Stephen Addy, Kirsty Holstead (James Hutton Institute), Richard Lockitt (Lockitt Environmental), Angus Bayne (Wester Gospetry Farm)

Soil erosion after potatoes, especially in wet autumns which have been prevalent recently in Eastern Scotland, can be a serious threat to farming sustainability and generates significant externalities Recent work at JHI (Vinten et al., 2012) has highlighted the efficacy (up to 20 tonnes eroded soil entrapped/ha potato field) and cost-efficiency (ca. £1k costs per field) of sediment fences for control, where weather conditions make post-harvest cultivations required under GAEC rules (for receipt of single farm payment), difficult to achieve. Agri-Environment consultant Richard Lockitt contacted the institute when one of his clients requested a sediment fence to mitigate a potential erosion risk in a field close to his steading which grew potatoes in 2013. Previously, a great deal of erosion had occurred from the field concerned, when he had grown potatoes, leading to a large amount of sediment accumulating in his steading, at significant expense.

We identified a 100 m length on a contour cutting across the bottom corner of the field, which removed approximately 0.2ha from production from the field. The position of the fence line was surveyed onto a contour (≡±2cm), using an RTK GPS systemon 5 February 2014. The dug in fence material used was HYTEX-Terrastop Mono60. A single tensioned wire ran along the top, onto which the fabric was tied. The potato crop was sown in ridges up and down the slope, with end ridges running parallel to the fence and a buffer zone of ca.5m along the fence. The crop was harvested in good conditions and winter cereals were sown, except for the 5m buffer area along the fence. The corner of field behind the fence was left fallow. An initial ground level survey was done using the RTK –GPS system in Nov 2013 and repeated in February 2014.

We also organised a meeting on site on 15th January 2014 to discuss soil erosion and its mitigation and to demonstrate the various erosion control measures Angus uses at Wester Gospetry. Participants were asked to complete a questionnaire to provide feedback to inform the James Hutton Institute's research work on uptake of measures for diffuse pollution control, concerning the feasibility and acceptability of sediment fences compared with other accepted measures of erosion control.

Summer 2013 was dry and there were no problems harvesting the crop. Conditions were good for sowing winter cereals after the potato crop. There was no evidence of soil erosion either in the potato crop, or in the winter cereals, during summer and autumn 2013. However, from mid-January 2014, we had exceptionally wet conditions till late February 2014. This has led to considerable erosion from the winter cereal field, mainly associated with tramlines. This has been efficiently captured by the sediment fence, and several fans of deposition could be seen. The RTK-GPS survey estimated total volume of soil deposited to be 3.24 m^3.The workshop was attended by a mix of agencies (5), farmers/potato contractors (8), consultants (3), local and national government (3),NGOs (3) and a water company (1). We have only 3 questionnaires returned as yet. The workshop participants were enthusiastic, although the comment from one farmer participant that edge of field measures are "fire brigade" measures which in themselves will not reduce erosion was highly pertinent to developing a treatment train approach to soil erosion control in the field.

In conclusion, although there was much less erosion than in previous trials, the sediment fence was technically highly effective in controlling sediment loss from erosion. The farmer was satisfied with installation and performance, as it took a significant "anxiety factor" away from his management of this field.

The new SRDP funding (2015 onwards) is likely to provide for funds for sediment traps and bunds, so if these can be integrated into greening measures such as hedges, buffer strips, detention ponds and wetlands, they have the potential to become part of the diffuse pollution mitigation toolbox.

AJA Vinten, K Loades,S Addy, C Abel, S Richards, M Stutter, Y Cook, H Watson, C. Taylor, N Baggaley, R Ritchie (2013). Assessment of the use of filter fences for erosion control in the aftermath of potatoes on sloping land in Eastern Scotland. Science of the total Environment. 10.1016/j.scitotenv.2013.07.086

Sitobion avenae - the grain aphid: is it a new vector threat to your potato crop?

Brian Fenton and Gaynor Malloch
James Hutton Institute, Invergowrie, Dundee DD2 5DA

Sitobion avenae, the grain aphid, is an important pest on wheat, barley and oats in the UK as the species is one of the main vectors of Barley Yellow Dwarf Virus (BYDV). In addition, the grain aphid is also a vector of potato virus Y and recent research suggests that the species is a much more efficient vector than previously reported.

Several classes of insecticide used for aphid control act on targets in the central nervous system of the insect and some aphid pests have evolved resistance to the chemicals rendering them ineffective. Pyrethroids affect the function of voltage gated sodium channels in the insect nervous system causing uncontrolled firing of the neurons and eventual death. Pyrethroid resistance in insects was found to be linked to mutations in the para-orthologous sodium channel genes and two common phenotypes were identified and named kdr (knockdown resistance) and super-kdr.

Despite the regular use of pyrethroids there had been no firm reports of resistance in *S. avenae* until 2011 when *S. avenae* with resistance began appearing in increasing numbers in English suction traps. By 2012 the resistant aphids were reported as far north as Newcastle (S. Foster, Rothamsted Research, personal communication). Resistant forms of *S. avenae* will have an advantage anywhere that pyrethroids are used, whether they are the intended target or not and the spread of resistant forms could result in more grain aphids encountering potato crops.

In order to determine if pyrethroid resistance *S. avenae* are present in Scotland we have examined samples from Scottish suction traps for resistance mutations. Conventional resistance analysis is based on the presence / absence of the L1014F mutation (kdr) and we have monitored this mutation. However, we have also attempted to sequence a larger fragment of the sodium channel gene which would indicate if any of the other previously identified mutations found in other insects are present, and if any novel mutations are found in Scottish populations of *S. avenae*. If pyrethroid resistance is detected in Scottish populations of the grain aphid it could have implications for control strategies and for potential virus transmission in both cereal and potato crops.

Molecular marker development and application to potato breeding programmes

Vanessa Young[1,2], Karen McLean[1], Finlay Dale[1,2], Glenn Bryan[1], Csaba Hornyik[1] and Ankush Prashar[1]

[1] James Hutton Institute, Invergowrie, Dundee DD2 5DA

[2]Mylnefield Research Services, Invergowrie, Dundee DD2 5DA

To ensure that modern potato breeding becomes more efficient in meeting changing needs, there is a strong requirement to develop effective links between modern molecular genetics and the improvement of potato (*Solanum tuberosum* L.). Conventional potato breeding relies on multiple rounds of phenotypic selection for desirable traits, rather than exploiting genotypic information. Typical potato breeding programmes result in many clones being discarded at an early stage leaving relatively small numbers of clones from which to select genotypes possessing important traits (e.g. disease resistance and processing qualities).

Recent progress has been made in mapping and developing markers diagnostic for simply inherited traits. For marker assisted breeding to become economically viable, it will be important to develop many valuable markers that can be used simultaneously to carry out multi-trait diagnostics on breeding material.

The population chosen for this study is the '06H1' cross, a highly heterozygous cross between two F_1 hybrid clones each from a diploid Group Tuberosum x Group Phureja cross. This cross incorporates the characteristics seen in the conventional cultivars of *S. tuberosum* tetraploids with the distinctive flavour and texture characteristics traits seen in its diploid relative *S. tuberosum* Group Phureja.

Extensive field trialling and phenotyping was carried out over 3 years on the 06H1 population with data on 22 traits collected (e.g. yield, maturity, sprouting and cooking quality characteristics). Using a panel of 8,300 single nucleotide polymorphic (SNP) markers, the population was genotyped, linkage maps were created and quantitative trait locus (QTL) analysis was performed. Several significant QTLs were identified in this population providing new insights into the genetic control of potato traits.

This study offers the potential to identify markers associated with QTLs and turn them into tools for effective trait selection in commercial potato breeding programmes.

Towards the identification of genes for tuber shape formation and eye depth development

Csaba Hornyik, Ankush Prashar, Vanessa Young, Karen McLean, Sanjeev Kumar Sharma, Michele Liney, Gaynor McKenzie, Yun Wu, Gavin Ramsay, Finlay Dale and Glenn Bryan
James Hutton Institute, Invergowrie, Dundee DD2 5DA

Tuber shape and eye depth are important potato traits that impact directly on the use of potato varieties, particularly in potato processing. In our institute we have generated a large potato population of over 300 progeny plants by crossing two very different parental lines. The progeny plants show a wide range of variation in shape and eye depth scores. We have scored tuber shape and eye depth on this family and have mapped the traits to two main locations. For shape about two thirds of the detectable genetic variation is due to the 'major' gene on chromosome 10, and the remainder to the other gene on chromosome 2. For eye depth, we also see that the major effect maps to chromosome 10, very close to the major shape gene. These preliminary data allowed us to use a candidate gene approach to identify genes involved in tuber shape and eye depth development.

By identifying molecular markers on chromosome 2 and 10 of the potato genome which show co-segregation with tuber shape and eye depth we could define the possible location of genes involved in this processes. According to the annotated gene functions we chose 4 candidate genes on chromosome 2 and 4 genes on chromosome 10 for further investigation. These are transcription factors and genes involved in hormone pathways connecting to developmental aspects of plant biology. Cloning of these genes is ongoing and we are looking for single nucleotide polymorphism (SNP) which could be used for new marker development for tuber shape and eye depth. Using these markers we will refine the mapping of these traits.
Semi-quantitative RT-PCR technique was used to examine expression levels of the candidate genes in different tissues. A new set of frozen plant material was prepared from chosen clones of 06H1 diploid population last year, also using potato cultivars with different tuber shapes and eye depth. This will be the basis of future gene expression studies focusing on genes having role in tuber shape and eye depth development.

Additionally, a collection of 350 potato cultivars was assessed for tuber shape and association mapping was done with the data. Moreover, a *Solanum stenotomum* diversity population was measured for tuber shape and assessed for eye depth to enable finer mapping of these important tuber traits.

R&D into Blackleg caused by *Pectobacterium atrosepticum*: An update

I K Toth[1], G Cahill[2], J G Elphinstone[3], S Humphris[1], D. Kiezebrink[4], G S Saddler[2] and S J Wale[4]
[1]James Hutton Institute, Invergowrie, Dundee DD2 5DA
[2]Science and Advice for Scottish Agriculture (SASA), Roddinglaw Road, Edinburgh, EH12 9FJ
[3]Food and Environment Research Agency (Fera), Sand Hutton, York, YO41 1LZ
[4]SRUC Aberdeen Campus, Craibstone Estate, Aberdeen AB21 9YA
E-mail: ian.toth@hutton.ac.uk

Dickeya solani has been a significant threat to potato production throughout Europe. As a result, there has been a period of intense research to better understand the pathogen and possible methods for its control. Although *Dickeya* species remains a threat, the closely related pathogen *Pectobacterium atrosepticum* continues to be the major issue for potato production in Northern Britain. Since 2007 there has been a steady increase in seed area downgraded or rejected within the Scottish Seed Classification Scheme as a result of blackleg, caused by *P. atrosepticum*. This increase has been attributed to either changes in the pathogen, management practices or the environment. Certainly, the increase in blackleg has coincided with a series of very wet growing seasons, the removal of sulphuric acid as a means of haulm destruction and increasing consolidation within the industry, resulting in fewer but bigger businesses growing a wider range of cultivars. Further it is clear from growing crop inspections returns that blackleg is strongly influenced by disease incidence in the preceding seed crop. It is therefore concerning that blackleg can be found in Pre-Basic crops as early as the second field-grown generation. More so when considering that disease incidence, in general, will rise steeply to a plateau in subsequent generations once initial infection has occurred.

A three year project, funded by Potato Council and Scottish Government, has recently been commissioned to identify how and when early field generations become infected by *P. atrosepticum*. The rationale being that any delay in the initial infection will have a positive effect in later generations. Experiments will also investigate the effect of removal as a means of haulm destruction. The project has 5 main components:-

- Monitor commercial Pre-Basic 1 crops through a 3 year multiplication cycle.
- Investigate the movement of *P. atrosepticum* from infected to healthy plants.
- Investigate the routes by which daughter tubers become infected once *P. atrosepticum* is present in or on a plant.
- Identify whether a change in the population of *P. atrosepticum* strains has occurred in recent years.
- Compare the effectiveness of sulphuric acid with currently used haulm destruction programmes to determine their relative impact on spread of *P. atrosepticum* to daughter tubers.

Analysis of available data on the distribution of seed crops will also be carried out to determine if proximity to crops exhibiting blackleg symptoms increases the risk of blackleg in Pre-Basic crops and in their subsequent generations.

Controlling potato blackleg: The Scottish and UK approach

Gerry Saddler, Greig Cahill, Maureen McCreath & John Kerr
Science and Advice for Scottish Agriculture (SASA), Roddinglaw Road, Edinburgh, EH12 9FJ
Email: gerry.saddler@sasa.gsi.gov.uk

Potato blackleg and soft-rot are a major cause of lost production in Northern Europe. The diseases can be caused by a number of bacteria including; *Pectobacterium atrosepticum* (Pba), other *Pectobacterium* spp., *Dickeya dianthicola* and *D. solani* (Dsol). Currently, control of blackleg, caused predominantly by Pba in Scotland and in >75% of cases in England and Wales, is carried out through a multi-faceted approach comprising high-quality disease free planting material, industry good practice and targeted legislation (seed certification). Healthy planting material arises from disease-tested micro-plants which are multiplied through mini-tuber production under controlled conditions. Field grown potatoes are multiplied initially as pre-basic seed and a zero-tolerance for a number of faults and diseases, which include blackleg, is applied. Growing crop inspections during every year of field multiplication is designed to further limit/remove heavily diseased crops from the production chain.

Blackleg caused by Dsol was found for the first time in Scotland in a small number of crops in 2009 and then subsequently in 2010. However, the introduction of targeted Scottish legislation in 2010, making it illegal to plant potatoes infected with *Dickeya* spp., has resulted in no further cases. This successful outcome and our continuing freedom from this pathogen is largely due to the wide-spread support from industry and specifically a growing awareness that care is required when sourcing seed. Sporadic findings continue to occur in England and Wales since its first occurrence in 2007. The nature of the industry south of the border made it impractical to introduce Scottish-style legislation, however in every case to date infection has been traced back to non-UK origin seed.

An overview of the current situation and control measures for both pathogens will be presented alongside some indications as to how current research may shape future control strategies.

Science and Advice for Scottish Agriculture
Agriculture, Food and Rural Communities Directorate

T: 0131-244 8890 F: 0131-244 8940
E: info@sasa.gsi.gov.uk

The Scottish Government

Pre-consultation paper on Revisions to the Annexes of 2002/56/EC

John Kerr
Science and Advice for Scottish Agriculture (SASA), Roddinglaw Road, Edinburgh, EH12 9FJ

Over the past few years the EU has been working towards a harmonised approach to nomenclature and meaningful minimum quality standards for seed potatoes. During the negotiations the UK sought views from stakeholders to in order to determine the key requirements for UK seed and ware production.

The main issues of contention were:

- Tolerances
- Permissible number of generations and critically the ability to use these generations with some flexibility.
- Maintaining the provisions detailed in the community grade legislation.

Member States may not impose higher standards with regards to placing on the market unless the more stringent requirements concern particular harmful organism and the Member State has obtained the Commission's authorisation.

The commission have set a deadline for implementation of 31st December 2015

The changes to the tolerances will be discussed – of particular note is the substantial relaxation of the virus tolerances at all grades other than E (analogous to the existing Scottish A).

There are various options for implementation including:

1. Adoption of the Community Grades as they are drafted with no other controls
2. Reject the use of the harmonised grade nomenclature and use our current tolerances with new Scottish grade names
3. (**Preferred**) Adopt the Community Grades and tolerances but apply specific additional statutory controls for production within our territory
4. Adopt the Community Grades and tolerances but apply additional controls under a Higher Voluntary Standard scheme.
5. Adopt the Community Grades and tolerances but allow individual companies to have their crops inspected by officials to their own defined higher standards on a commercial quality basis.

The paper will discuss these issues in detail and will provide the audience with the opportunity to feed in their views in this pre-consultation period.

Finlay Dale
Secretary, SSCR Potato Committee
The James Hutton Institute
Dundee DD2 5DA
Tel: 01382 568740
Email: Finlay.Dale@hutton.ac.uk

Sharon Neilson
Events Co-ordinator
The James Hutton Institute
Dundee DD2 5DA
Tel: 01382 568750
Email: events@hutton.ac.uk