Pietro Iannetta Collaborative and Student Projects 2009-10

Scientific Collaborations on Work Package Research

Capsella seed dormancy

Characterisation of secondary dormancy and myxospermy in wild arable plant species: *Capsella* as a model

We have shown the *Capsella* produces two types of viable seed, mature light-brown (myxospermous) seeds and less mature dark-brown (non-myxospermous) seeds. However, the functional significance of myxospermy (seed coat mucus), has not been shown scientifically. The light- and dark-brown seed types have characteristically different dormancy (primary and secondary), germination and longevity characteristics. These findings have implications for our understanding of seed persistence, and the control of dormancy and germination.

Collaborators:
Dr Peter Toorop - Royal Botanic Gardens Kew, Millennium Seedbank
Dr Darren Wells and Dr Tara Holman – University of Nottingham

Cross-species microarray typing

Bioinformaics Using Cross-species Array Diagnostics: *Capsella* as a model

Here we exploit the high genetic synteny that exists between *Capsella* and the genetic model plant *Arabidopsis*. DNA extracted from functionally distinct (time-to-flowering) ecotypes of *Capsella*, have been hybridised against *Arabidopsis* (*Affy1*) micro-arrays. The data gathered will allow us to assess genetic changes

between the various *Capsella* ecotypes, and indicate if the specific gene differences reflect functional differences. In addition, this research will generate an array-based tool that can be used for *Capsella* gene-expression studies.

Collaborators and Sponsors:
Dr Martin Broadley - University of Nottingham, Sutton Bonington Campus
Genomic Arabidopsis Resource Network (GarNET)

Externally Funded Projects and Consultancies

European Union: 'Legume Futures'

Legume Futures is supported by the European Union - Framework 7 (call - FP7-KBBE-2009-3). This research is aimed at optimising the use of legumes in European agricultural systems and promoting the partnerships needed to support the public policy outcomes sought. This network of 18 experimental sites, in 12 countries, will be the focus of interaction with farmers, SMEs, other businesses, and policy makers. The research is planned around the appreciation of how biological nitrogen fertilisation and the production and use of plant protein lies at the heart of many of the global, regional and local environmental challenges arising from agriculture. It will then deliver the results into the farming community and other commercially interested third parties. The website www.legumefutures.eu is currently under construction but will be accessible soon. The project is coordinated by Dr Bob Rees and the Scottish Agricultural College.

University of Umea, Sweden: 'Wild indigenous legumes'

Characterisation of efficient symbionts via microbial isolation and root nodule structure: a comparison of N_2-fixing legumes from an island (Scotland), and those form a continental ecosystem (Sweden)

The wild plant species found within fields can be characterised by the remarkably low numbers of legumes within their ranks. Similarly, evidence has shown that the diversity of nodulating bacteria within arable fields is also low. Despite this, wild legumes offer much due to their potential as providers of biologically fixed nitrogen, and the other ecosystem services that they can offer, for example *via* 'integrated pest management'. This project provides a comprehensive survey of the wild indigenous legumes in Sweden and Norway. This survey also has a strong 'banking' element, as the seeds and nodules collected for structural, serological studies and microbiology studies will also form a germ bank of seeds and nodulating bacterial strains. The isolated nitrogen-fixing bacteria will be assessed for their ability to nodulate a wide range of host-plants, and for their relative nitrogen fixing capability. Particular focus will be paid to phylogenetics of nodulating bacteria from three related genus's *Lathyrus*, *Pisum* and *Vicia*. This work is also carried out in collaboration with the Royal Botanic Garden Edinburgh (Dr Greg Kenicer), and Edinburgh University Institute of Molecular Plant Sciences.

Companion planting: of raspberry canes with wild leguminous species as novel method of biocontrol agents

The quality of raspberry plants and fruits is decreased by the activity of a range of crop pests and pathogens which are becoming very difficult to control under new EU restrictions on pesticide use. This situation is exacerbated by the lack of functional biodiversity (natural enemies of key pests) within cropped areas. However, more recently, cost efficient 'Integrated Pest Management' and 'ecological engineering' techniques have been developed that facilitate practical coexistence of crops with other specific 'companion' plants which are proven to promote biocontrol agents. In particular, the use of companion legume species may limit soil borne pathogens such as nematode and fungal infections, whilst also applying a natural source of biologically fixed nitrogen. Crop plants, such as raspberries could benefit from the nitrogen compounds leached into the soils by N_2-fixing legumes, thus reducing the necessity for agrochemical N-fertiliser applications: which are often associated with over-vigorous canes, and increased pest and disease incidence. This project uses wild legumes mixtures as companion plants for raspberries to assess their effectiveness.

Collaborators and Sponsors:
Scottish Society for Crop Research, Professor Stephen Wratten - University of Lincoln, NZ, Mr Peter Marshall & Co, Herbiseed Ltd

Scottish Enterprise/SCRI: 'Commercialisation Award'

A platform enabling technology to characterise wild plants for their therapeutic potential: *Capsella* as a model.

This research is funded by a 'Commercialisation Award': from a joint venture between Scottish Enterprise and SCRI. It aims to identify (and patent), particular novel bioactives from *Capsella*. Wild plants (weeds) that are indigenous to the UK are not exploited fully as novel crops and important sources of valuable therapeutics for human and animal wellbeing. This project aims to develop the potential of wild arable plant species as novel high-value crops, expand the diversity of available crops and enhance the economic resilience of the farming sector.

Collaborators and Sponsors:
Dr Val Ferro and Dr Alexander (Sandy) Gray - University of Strathclyde, Scottish Enterprise, Mylnefield Research Services Ltd.

Student Projects

PhD Students

Engineering novel geotextiles from an understanding of the dynamic properties of seed coat mucus – Miss Wenni Deng

This is one of the first studentships offered through the *Centre for Environmental Change and Human Resilience* (CECHR), a new initiative between the University of Dundee and SCRI. The aim of CECHR is to establish interdisciplinary research to promote sustainable use of the earth's resources by fostering collaboration between science, social science and policy. This project links the sciences of seed biology and civil engineering, and the joint supervisor is Professor Dong-Sheng Jeng (Civil Engineering). The aims of the project are to model mathematically the fluid dynamics of *Capsella* seed coat mucus. It is hoped that the knowledge gained can also be applied to the design of novel geotextiles.

Other student projects

Therapeutic properties of *Capsella*

Capsella seed epigenetics

Numerous student projects have been carried out to support this fundamental research into seed functional biology and the therapeutic potential of weeds. In particular, student support has been received from MSc Biotechnology students from the University of Abertay Dundee.

These projects have included: seed coat mucus; the therapeutic properties of weeds; seed epigenetics; isolation and characterisation of nodulating bacteria.

In addition, the research is also supported by students via The Nuffield Foundation, and these short investigations include: developing hydroponic based techniques to culture weeds at commercial scales, the culinary properties of *Capsella*; these projects have been carried out in association with Scot-herbs Ltd.

This research is carried out in collaboration with other scientists throughout SCRI, and includes those based within Dundee University Division of Plant Sciences †. In particular, Graham Begg, Nick Birch, Cathy Hawes, Euan James, Alison Roberts, Janet Sprent †, Geoff Squire, Ian Toth, Mark Young, Tracy Valentine, Philip White, Jane Wishart.

Last Updated October 2009