

Geraint Parry: geraint.parry@liverpool.ac.uk

Project Report: **CIG PCIG10-GA-2011-304048 Acronym: PLANTNPC**

Project title: **Functional Characterisation of the Plant Nuclear Pore Complex**

Research Productivity

Objective A- To establish a genetic network of nucleoporin function

We have evaluated the phenotypes of a wide range of nucleoporin mutant plants and have created many appropriate double mutants. This has revealed a range of pleiotropic phenotypes in plants deficient in certain nucleoporins (*nup*). However the situation is not straightforward as mutating individual nucleoporins results in three phenotypic outcomes 1, Embryo Lethality 2, General growth phenotypes characterised by smaller roots, early flowering and reduction of stature. 3, Wildtype growth where there is little phenotypic change. These mutants have been used both in my lab for subsequent analysis and disseminated to a number of labs in Europe and the USA for use in characterisation of the particular growth response there are interested in.

In recent times we have expanded our research in order to attempt to characterise the unknown plant RCC1-ortholog. We are taking a targeted proteomic strategy that will use transgenic RAN1 plants to identify interacting proteins. This will move research in the lab forward into this novel area. The proteomic study is 50% funded by the University of Liverpool Technology Directorate.

Objective B- To determine specificity of NUP function

We evaluated the nuclear morphology and the mRNA accumulation in a range of *nup* mutants characterised in *Objective A*. We found that nuclear shape is not consistent in all mutants and that certain *nup* mutants have more circular nuclei. The reason for this alteration is not immediately clear but we are investigating the possibility that in these mutants there is an altered linkage between the nuclear envelope and the cytoskeleton, as has been observed in plants with defects in proteins that reside at the NE.

More surprising was the finding that we observed differences in the amount of nuclear mRNA accumulation in different *nup* mutants. Broadly we show that the NUP107-160 sub-complex is required for mRNA export but the NUP62 sub-complex appears not to be necessary. The amount of mRNA accumulation was quantified in a novel method that allowed us to make more general statements about how different sub-complexes contribute to mRNA export.

A PhD student, Yi Fang, is currently introducing a range of transgenic lines into *nup* mutants in order begin an analysis into the specificity and temporally dynamics of nuclear protein import. This work will come to fruition in the coming year.

Objective C- To determine the effect of the NPC on gene expression

We have performed a number of experiments to assess the changes in global gene expression in certain *nup* mutants. Firstly we extracted RNA from *nup160* and *nup62* seedlings and performed a microarray analysis on these samples. When compared to wildtype samples, we showed that a surprisingly small number of genes had altered gene expression. However a proportion of these genes are involved in nuclear transport and so is suggestive of a feedback mechanism where nuclear transport components are upregulated in *nup* mutants.

To further investigate the role of the NPC in nuclear mRNA export we performed RNAseq on total and polysome RNA fractions in *nup160* and *nup62* mutants in order to assess which transcripts are differentially exported from the nucleus in these mutants. This work was performed in partnership with the University of Liverpool Technology Directorate that contributed 50% of the finances for this work. The bioinformatic analysis of this large datasets is currently underway and will inform the future direction for research in the lab.

Dissemination activities:

Review Article: **Parry G** (2013) Assessing the Function of the Plant Nuclear Pore Complex and the Search for Specificity. *Journal of Experimental Botany* **64** (4), 833-845

Meeting Report: Graumann K, Bass H, **Parry G*** (2013) SUNrises on the International Plant Nucleus Consortium. *Nucleus* **4**, 1-5

Research Article: **Parry G** (2013) Components of the Nuclear Pore Complex Play Multiple Roles in Plant Growth *Under Review at Plant Physiology, April 2014.*

International Research Presentations:

- *Oral Presentation*: Investigating the *Arabidopsis* Nuclear Pore Complex. **Workshop on Mechanisms of Nucleocytoplasmic Trafficking 2013**, Woods Hole, MA, USA
- *Oral Presentation*: 'Components of the Nuclear Pore Complex Play Multiple Roles in Plant Growth'. **International Plant Nucleic Group Meeting 2013**, Oxford, UK
- *Oral Presentation*: 'Investigating the roles of the plant nuclear pore complex in gene expression and development'. **SEB Main Workshop 2012**, Salzburg, Austria

Research Group Size at University of Liverpool:

- Liverpool:China Partnership PhD student 2013- 2017: Yi Fang
- University of Liverpool MBioSci students: Graeme Wells, Brendan Brady
- Number of University of Liverpool Undergraduate students: 8 students over past 3 academic years.

Currently I am a 100% independent researcher at the University of Liverpool but my contract ends in September 2014. We are under negotiations for an extension in order to allow further development of the research group and to obtain longer term funding for PDR and technical staff.

Research Funding:

- British Society Plant Pathology Summer Studentship: 'Investigating the relationship between Geminivirus infection and the plant nuclear transport apparatus'. Summer 2014. **Total award - £2500**
- University of Liverpool Technology Directorate Research Grant: 'Identification of the plant RCC1-ortholog' April 2014. **Total Award- £1500**
- Liverpool China Scholarship Council PhD studentship: '*Characterisation of the Plant Nuclear Pore Complex and Defining its Functional Role in Growth and Development*' October 2013- Sept 2017. **Primary PI** (with Dr Luning Liu)
- University of Liverpool Technology Directorate Research Grant: '*Investigating the role of the Plant Nuclear Pore Complex in nuclear RNA export*'. May 2013. **Total Award- £9000**
- Society of Biology Undergraduate Research Bursary: '*Investigating the Role of the Plant Nuclear Pore Complex in control of Nuclear Morphology and Nuclear Transport*'. Summer 2013. **Total Award- £1400**
- British Society Plant Pathology Summer Studentship: '*Investigating the Nuclear Pore Complex as a possible target for developing resistance to Plant Viruses*'. Summer 2013. **Total award - £2100**
- British Society Plant Pathology Summer Studentship: '*Investigating the Relationship between the Plant Nuclear Pore Complex and Viral Infection*'. Summer 2012. **Total award - £2100**
- Royal Society Research Grant: '*Investigating the relationship between the Plant Nuclear Pore Complex and Viral Infection*'. April 2012- March 2013. **Total Award- £10898**

Outreach Activities:

- Organiser of the Annual Liverpool University **Plant Science Symposium** for PhD students and post-doctoral researchers
- Principle organiser of the Liverpool event of '**Worldwide Fascination of Plants Day**' at the Liverpool World Museum. In 2013 over 1000 members of the public attended the day long session.
- **February 2014: UoL Humanists**: 'The Wonders and Worries of GM crops', University of Liverpool
- **August 2013: Skeptics on the Fringe**: 'The Science behind GM crops: What they are and what they can achieve', Banshee Labyrinth, Edinburgh
- **July 2012/2013: Gatsby Plants Summer School**: Tutorial Supervisor
- **February 2013: Ignite Liverpool**: 'GM Crops: What the Future Holds' Leaf Cafe Bar, Bold Street, Liverpool
- **January 2013: Merseyside Skeptics in the Pub**: 'Future Food: Why GM is Important', Head of Steam, Liverpool
- **February 2012- April 2014**: Five school talks outlining the science behind Genetically Modified crops. Merseyside Area.