Dr Jill Harrison
BSc(St.And.), MSc(Edin.), PhD(Edin.)

Senior Lecturer

Area of research

The evolution of plant body plans

Life Sciences Building,
24 Tyndall Avenue, Bristol BS8 1TQ
(See a map)

+44 (0) 117 39 41189
jill.harrison@
bristol.ac.uk

Summary

The conquest of land by plants over 450 million years ago was one of the most significant events in our planet's history, and was underpinned by a series of key innovations in plant architecture during evolution.

Our group aims to identify the developmental and genetic basis of two such innovations- three dimensional shoot growth and branching- in a range of model systems representing different stages of plant evolution.

More generally, we are interested in how plant shape arises by development, and wish to transfer knowledge from our model systems to flowering plants to design new shapes and improve productivity.

Biography

2018-present Senior Lecturer, University of Bristol

2017-2018 Royal Society University Research Fellow and Senior Lecturer, University of Bristol

2015-2017 Royal Society University Research Fellow and Proleptic Lecturer, University of Bristol

2010-2015 Royal Society University Research Fellow and Gatsby Research Fellow, Department of Plant Sciences, University of Cambridge.

Associate Lecturer at Newnham College, University of Cambridge.

2008-2009 Browne Research Fellow, The Queen’s College, Oxford.

2002-2008 Post-Doctoral Research Associate, Plant Sciences Department, University of Oxford.

1998-2002 Ph. D. University of Edinburgh.

1997-1998 M. Sc. University of Edinburgh/ Royal Botanic Garden, Edinburgh.

1996-1997 Medical Laboratory Scientific Officer, University of Oxford.

1992-1996 B. Sc. Joint Hons, University of St. Andrews.

Activities / Findings

The radiation of life on Earth depended on the colonisation of land by plants. Plants' photosynthetic activity enriched oxygen in the atmosphere, plants made the first soils and plants make food and homes for animals. The greening of the land started by the formation of thin soil crusts growing fungi, lichens and algae, and land plants originated from these algae[1-3]. The first land plants had a single tiny stem capped in a reproductive structure, as in modern mosses and other bryophytes. In contrast, most of today's plants have large and elaborate branching forms nourished by vascular transport[4,5]

My lab's research aims to identify genes and developmental changes that enabled such vascular plant forms to arise during evolution. Whilst this question is simple to articulate, it is hard to address because bryophytes and vascular plants have such disparate overall forms and patterns of development. A handful of tiny fossils suggest that plants gained a capacity to branch before they started to make shoots with indefinitely proliferative shoot tips and leaves[4,5].

Using liverwort[6], moss[7-10] and lycophyte[11,12] model systems we have identified likely roles for *PIN*[8,9], *CLAVATA*[10] and *KNOX*[11] genes in the origin of branching and shoot growth. I wish to build on this work to show the pattern of development in primitive branching forms and identify ancestral mechanisms for branching in the vascular plants. I also wish to identify the molecular basis for the origin of stem cell functions and proliferation in vascular plant shoot tips.

If you would like to join my lab please get in touch to discuss your ideas.

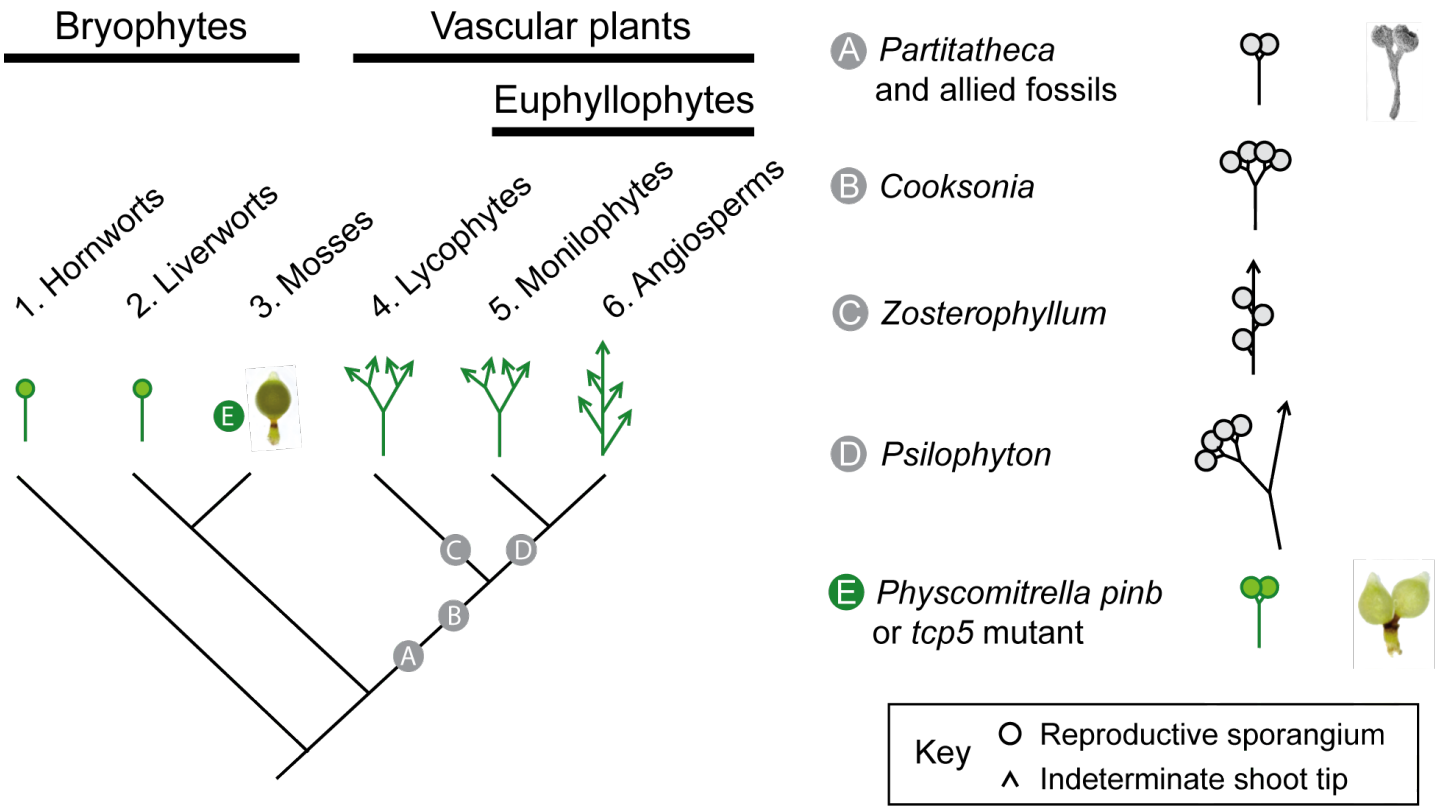

Figure 1: The line diagram represents the evolutionary past of six extant land plant groups. Whilst bryophytes and vascular plants have widely divergent shoot forms (shown in green), fossil intermediaries similar to (A) *Partitatheca* and (B) *Cooksonia* suggest that branching was an early innovation in plant evolution[4,5]. *PIN* genes regulate branching in angiosperms, and perturbation of PIN function in a moss induces branching (C) to give plants a similar form to *Partitatheca* fossils[8].

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3. Harholt et al. (2016). Why plants were terrestrial from the beginning. Trends in Plant Science *21*, 96-101.

4. Harrison (2017). Development and genetics in the evolution of land plant body plans. Philosophical Transactions of the Royal Society B *372*, e20150490.

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6. Solly et al. (2016). Regional Growth Rate Differences Specified by Apical Notch Activities Regulate Liverwort Thallus Shape. Current Biology 27, 1-11.

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8. Bennett et al. (2014). Plasma membrane-targeted PIN proteins drive shoot development in a moss. Current Biology *24*, 2776-2785.

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Memberships

Organisations

School of Biological Sciences

Research groups

- Evolutionary Biology
- Plant and Agricultural Sciences

Labs

- Evolution of Plant Body Plans

Links

- Group members
- Collaborations
- Lab protocols
- News
- Publications at Google Scholar

Recent publications

- Coudert, Y, Novak, O & Harrison, CJ, 2019, 'A KNOX-cytokinin regulatory module predates the origin of indeterminate vascular plants'. *Current Biology*, vol 29., pp. 2743 - 2750
- Dennis, R, Whitewoods, C & Harrison, CJ, 2019, 'Quantitative methods in like for like comparative analyses of Aphanoregma (Physcomitrella) patens phyllid development.'. *Journal of Bryology*.
- Harrison, CJ & Roeder, AH, 2019, 'Editorial overview: Scaling development through the plant tree of life'. *Current Opinion in Plant Biology*.
- Parry, G & Harrison, CJ, 2019, 'GARNet gene editing workshop'. *New Phytologist*, vol 221., pp. 640-643
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