

Vegetative diaspore ontogeny and liberation mechanisms: towards resolving major problems in moss systematics and phylogeny

Project Description

The main aim of this project is to conduct a systematic study of the production, morphologies and liberation mechanisms of asexual propagules in mosses and thus provide novel taxonomic data sets to be used together with molecular data to resolve moss phylogeny.

Background

In the last decade huge progress has been made on bryophyte phylogeny. Molecular data have had more influence on classifications than any other set of characters; however, there is now a general consensus that sequence data should not be used in isolation but in conjunction with morphological data. Whereas the major lineages in the hornworts and liverworts are fairly well resolved, in mosses, despite numerous sequencing studies, evolutionary relationships remain poorly understood and non-molecular data sets are urgently required. Mosses produce a wide range of asexual (vegetative) propagules; whilst aerial vegetative propagules produced by leafy gametophores are usually highly conspicuous structures used extensively by taxonomists, much less conspicuous and much less well known are those that form on the filament system of mosses (rhizoids and protonemata) and particularly protonemal gemmae. Recent studies have not only indicated that the latter are much more widespread than initially thought but also that their wide range of morphologies and liberation mechanisms, which equals those of their aerial counterparts, can be highly diagnostic taxonomic characters (at all hierarchical levels), which are often congruent with systematic information derived from molecular data. There are two fundamentally different mechanisms of diaspore liberation in mosses: a schizolytic one, involving detachment along cell walls, and a lysigenic mechanism involving the formation and rupture of a specialized abscission (Tmema) cell. There is limited information on the development and different morphologies of abscission cells and changes in cell wall chemistry that take place during their development and liberation and potential differences between groups remain unknown.

Objectives:

1. To examine the distribution of asexual propagules, their morphology and abscission mechanisms by a combination of morphological and developmental cytological studies on representatives of all the key moss clades. This will involve detailed examinations of wild and *in vitro* grown specimens.
2. To test the hypothesis that diaspore liberation mechanisms in mosses evolved independently several times (thus similar origins together with similar morphologies would be diagnostic of natural affinities) by using the ever expanding arsenal of cell wall antibodies available. Similar immunocytochemical studies have already proved invaluable in determining that the water-conducting cells of bryophytes are not homologous to those of tracheophytes and that they evolved independently several times within bryophytes.
3. To assess whether these novel morphological and immunocytochemical characters are congruent with recent systematic information from molecular data and to test novel hypotheses emerging from these data sets by sequencing work.
4. By combining extensive field observations and *in vitro* studies this work will also provide a unique opportunity to elucidate the roles of protonemata and the propagules they produce in the reproductive biology of mosses.

Student Training

This PhD will provide the student with an exceptional range of skills ranging from plant cell wall biochemistry, light and electron microscopy, bryophyte systematics and reproductive biology. The student will receive comprehensive training in: (i) *in vitro* culturing techniques; (ii) moss taxonomy, systematics (including molecular sequencing) and reproductive biology; (iii) a range

of light and electron microscopy techniques, including immunocytochemistry and confocal microscopy. There will also be ample opportunities to develop field identification skills through UK and overseas fieldwork. Throughout the PhD the student will be encouraged to communicate results to both scientific and public audiences for which training will be provided.

Supervisors

Dr. S. Pressel (s.pressel@nhm.ac.uk) and Prof. P. Knox (j.p.knox@leeds.ac.uk – <http://www.bmb.leeds.ac.uk/staff/jpk>)