



**Ciência sem Fronteiras (Science Without Borders)  
PhD Project Template:**

**\*\*Please use one form per project\*\***

Please complete & submit to [huw.lewis@ul.ie](mailto:huw.lewis@ul.ie) as soon as possible,  
but preferably before 23<sup>rd</sup> November

<b>PI name &amp; contact details:</b>	Dr. Achim Schmalenberger University of Limerick Life Sciences Schrodinger Building Limerick Ireland <a href="mailto:Achim.schmalenberger@ul.ie">Achim.schmalenberger@ul.ie</a>
<b>Department</b>	Life Sciences
<i>Has project been agreed with head (or nominee) of proposed registration school?</i>	Yes
<b>Research Centre / group affiliation:</b>	
<b>Research group / centre website:</b>	<a href="https://sites.google.com/site/environmicro/">https://sites.google.com/site/environmicro/</a>
<b>PI website / link to CV:</b>	<a href="http://www2.ul.ie/web/WWW/Faculties/Science%26Engineering/Departments/Life_Sciences/People/Achim%20Schmalenberger">http://www2.ul.ie/web/WWW/Faculties/Science %26 Engineering/Departments/Life Sciences/People/Achim%20Schmalenberger</a>
<b>Brief summary of PI research / research group / centre activity (2 or 3 lines max):</b>	
1) Microbial driven mobilization of soil nutrients from organic matter e.g. soil sulfur and phosphorus mobilization, nitrogen fixation and carbon sequestration. 2) Microbial mobilization of nutrients from primary minerals in rocks. 3) Microbial community analysis using DNA fingerprinting techniques.	
<b>Title &amp; brief description of PhD project (suitable for publication on web):</b>	
<b>Promotion of plant growth through deposition of biochar inoculated with phosphorus and sulfur mobilizing diazotrophic bacteria</b>	
<p>Biochar is produced when organic material is exposed to heat at 400-600°C in the absence of oxygen (pyrolysis). In South America this technique has been used in principle for millennia to improve soils and created the Terra Preta. The application of conventional fertilizers in agriculture has become ever more expensive and increasingly unsustainable as their production is highly dependent on fossil fuels and rock phosphate. Both of these resources are in great decline and therefore alternative fertilization regimes are in high demand. The burial of biochar in tropical soils is now regarded as an effective alternative to conventional fertilizers. Plant growth promotion effects by biochar include several factors, but its beneficial role is less well understood when it comes to microbial driven plant nutrient supply and biochar as a source for phosphorus (P) and sulfur (S) has received little scientific attention. During the charring of organic waste material to produce biochar</p>	



at temperatures below 650°C, P and S is retained largely in forms not directly available to plants. Bacteria isolated from previous projects of the PI are capable of mobilizing S and P may actively support nutrient mobilization and plant growth promotion. Indeed, the application of mycorrhizal fungi and diazotrophic bacteria is nowadays a well-established practice. In Brazil, the application of the nitrogen fixing (diazotrophic) bacterium Azospirillum has been widely used in sugar cane plantations and application have been recently expanded to other crops. Peat but also vermiculite has been widely used commercially in the past as microbe carrier for such soil inoculations.

In this study, new diazotrophic bacterial isolates capable of mobilizing P and/or S will be tested for their plant growth promoting capabilities. Biochar will be used in this project as a carrier of the bacteria since biochar has not only plant growth promoting capabilities but also functions as an ideal habitat for the newly introduced bacteria. Plant growth, the abundance of the microbial inoculant and the diversity of soil microbiota (bacteria and fungi) will be investigated in this approach to better our understanding of the beneficial effects of the combined addition of bacterial inoculants and biochar in pot experiments. Cultivation dependent and independent methods will be applied to characterize and identify bacterial and fungal communities, indigenous bacterial S and P mobilizers and diazotrophs and monitor the abundance of the introduced bacteria. These studies include selective cultivation, cultivation independent molecular fingerprinting methods based on PCR, 454 pyrosequencing and the application of stable isotopes will be used to trace the flow of nutrients from biochar to the plant host.

**Unique selling points of PhD project in UL:**

UL is home to some of Irelands leading researchers in biochar production, analysis and soil application (Carbolea Research Group) and soil microbial analysis (PI). This combination of experts is highly beneficial for this multidisciplinary project.

**Name & contact details for project queries, if different from PI named above:**

**Please indicate the graduates of which disciplines that should apply:**

Environmental Sciences, Life Sciences, Microbiology, Molecular Ecology, Plant Growth Promotion

**Please indicate whether students can apply for:**

**Sandwich programme only**

**Full PhD programme only**

**Either of the above**

**X**

**Ciência sem Fronteiras / Science Without Borders Priority Area:**

*Please indicate the specific programme priority area under which the proposed PhD project fits- choose only one (tick box):*

Engineering and other technological areas

Pure and Natural Sciences (e.g. mathematics, physics, chemistry)

Health and Biomedical Sciences

Information and Communication Technologies (ICTs)

Aerospace

Pharmaceuticals

Oil, Gas and Coal

Renewable Energy

**X**



Minerals	
Biotechnology	
Nanotechnology and New Materials	
Technology of prevention and remediation of natural disasters	
Biodiversity and Bioprospection	
Marine Sciences	
Creative Industry	
New technologies in constructive engineering	
Sustainable agricultural production	X