Profile

Stéphane Hacquard

What inspired your interest in plant science?

My curiosity for plants started when I was a Bachelor's student at the University of Nancy, France. I was fascinated by the ability of plants to produce their own energy through the process of photosynthesis and I realized the extent to which these organisms are critical for ecosystem functioning. I was particularly intrigued by the sophisticated mechanisms these sessile organisms have evolved to adapt to their environments and to rapidly respond to external stimuli in order to maximize survival. My first exposure to research was at the tree–microbe interactions laboratory at the Institut National de la Recherche Agronomique (INRA) Nancy (France) under the supervision of Valérie Legué. Scrutinizing morphological and molecular changes in tree roots during the establishment of the ectomycorrhizal symbiosis whetted my appetite for studying plant-associated microbes. I am deeply grateful to Valérie for giving me this fantastic opportunity that has definitively shaped my future scientific career.

Why did you decide to pursue a career in research?

The major factor that motivated me to pursue a career in science was, and remains to be, curiosity. I think that curiosity-driven research aimed at understanding general principles governing life is the most exciting and rewarding part of my job. Understanding fundamental processes of life without business goals is a unique aspect of basic research that can nonetheless lead to unpredictable breakthroughs. I started my PhD at INRA Nancy in 2007 when the biology field had just experienced the next-generation sequencing revolution. I immediately appreciated the potential for genome-enabled analysis of plant–microbe interactions, and was lucky enough to be part of a stimulating fungal genome-sequencing consortium led by Sébastien Duplessis and Francis Martin as part of a collaboration between INRA and the Joint Genome Institute. Being an actor at the forefront of this sequencing revolution was instrumental for my career trajectory and vital to the way in which I now integrate high-throughput sequencing technologies and functional genomics-based approaches in my current research projects. More recently, I realized that intellectual freedom is also a very important component that drives my passion for basic research. Designing research programmes, defining novel research lines, securing funding, and building strong collaborative networks are actually fun aspects of my scientific life.

What motivates you on a day-to-day basis?

Although understanding general principles of life is captivating, big discoveries do not happen every day in a scientific life! Fortunately, science offers so many other captivating aspects that largely compensate for the very few demotivating facets. On a daily basis, my motivation comes from the stimulating scientific environment

Box 1

Stéphane Hacquard holds a Master's degree in Forest, Ecology and Environment from the University of Nancy, France. In 2007, he started his PhD in the group of Francis Martin/Sébastien Duplessis (INRA Nancy, France) on the identification of plant pathogen effectors. In 2011, he undertook a 2-year post-doctoral position at the Max Planck Institute for Plant Breeding Research in Cologne (Germany) in the laboratories of Paul Schulze-Lefert and Richard O'Connell, where he characterized fungal transcriptional signatures linked to pathogenic transitions in plant leaves. In 2013, he got the opportunity to develop his own research project on the root microbiota of *Arabidopsis thaliana* in the group of Paul Schulze-Lefert. In December 2016, Stéphane was appointed as a junior group leader in the same institute and started his own group to study the fundamental mechanisms that underlie the structure and the functions of multi-kingdom microbial consortia colonizing plant roots. In 2016, he received a prestigious European Research Council (ERC) Starting Grant to support his research activities.

Stéphane is an Associate Editor with *New Phytologist*, where he joined the board in 2019.

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around me at the Max Planck Institute for Plant Breeding Research in Cologne (Germany), from the constructive discussions with colleagues and collaborators, from the immense satisfaction of being surrounded by so many talented young scientists, and from the fact that I can hopefully contribute to their paths towards scientific independence. Research is also fantastic in the way that it is a lifelong learning exercise. Every day, I enjoy the diverse and multifaceted aspects of the job and the fact that the field is moving so fast. This constant learning is challenging but at the same time exciting because it promotes critical and creative thinking. In particular, the research questions that drive my motivation on a day-to-day basis are: (1) Which microbial and host genes are important for microbiota establishment in plant roots? (2) Are microbe–microbe interactions relevant for community assembly and plant health? (3) How do plants coordinate microbiota establishment, defence responses, and abiotic stress tolerance?

Is there anyone that you consider to be a role model?

Many fascinating people have acted as role models during the different steps of my career. I would like to highlight my PhD supervisors Francis Martin and Sébastien Duplessis who are not only top scientists, but also exceptional mentors who are always open, enthusiastic, and positive. I remember the indescribable excitement in the whole laboratory back in 2006–2007 when the first analyses of multiple fungal genomes started. It was an incredible time where I realized that rigorous, innovative, and creative research could be done in a good humoured environment. I am also deeply grateful to Paul Schulze-Lefert, Director of the Plant–Microbe Interactions Department at the Max Planck Institute for Plant Breeding Research. He is an outstanding mentor with deep theoretical knowledge, endless curiosity for science, and visionary ideas. He gave me the tools, opportunity, and freedom to develop my independent research programme in an environment that promotes high scientific standards, constructive thinking, and intellectual freedom. He taught me the power of reductionist approaches for understanding fundamental ecological processes, establishing causality, and dissecting complex molecular processes. These concepts and tools have been critical in moving the plant microbiota field forward, but also instrumental in shaping my own research programme (Duran *et al.*, 2018).

What are your favourite *New Phytologist* papers of recent years, and why?

Due to my personal interest in root-associated fungal communities, I have highlighted two recent articles from the same group that tested whether plant processes that were primarily studied in the context of the arbuscular mycorrhizal (AM) symbiosis, have a broader influence on root colonization by nonAM fungi. In the first article, Fabiańska *et al.* (2019) investigated the extent to which soil phosphorus (P) shapes root-associated fungal communities in the AM nonhost species *Arabidopsis thaliana*. They reported that soil amendment with P has an extensive effect on fungal community differentiation in plant roots, but not in the soil compartment. They further demonstrated that this plant-mediated effect of soil P is controlled by the P starvation response, therefore modulating fungal community assembly in roots of an AM nonhost plant. In the second article, Xue *et al.* (2019) used *Lotus japonicus* mutants impaired at different stages of AM formation to investigate the role of the AM symbiosis pathway and AM fungi on the structure of root-associated fungal communities. They found that roots of *L. japonicus* mutants perturbed in AM symbiosis largely lack AM fungi and assemble 'abnormal' fungal consortia when grown in natural soils. Their results point to a mechanism in which both the plant host and the AM fungus contribute to fungal community assembly. These selected examples nicely illustrate the complexity of the interactions in the plant–microbiota–environment triangle and the importance of host–microbe and microbe–microbe interactions for microbial community differentiation.

What is your favourite plant, and why?

An easy riddle for the reader: 'My favourite plant is a flowering plant that my group and I extensively tracked across successive years throughout Europe. This annual dicotyledonous plant is small, ordinary, and barely edible but nonetheless drives my passion for mechanistic research.'*

References

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Key words: microbial genomics, microbial interactions, microbiota reconstitution, multitrophic interactions, pathogen suppression, plant growth promotion, root microbiota.

*Favourite plant riddle answer: *Arabidopsis thaliana*.