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Breaking the witches' spell: towards steering the soil microbiome for volatile-mediated control of the root parasitic weed *Striga*

Masteling Pereira, R.

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Curriculum vitae

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Raul Masteling Pereira was born on July 27th 1994, in the town of Pinheiro, Portugal. He spent his childhood in a small village nestled among the mountains, with his family having a strong connection to farming. His paternal grandparents were small-scale farmers who relied on the land for their livelihood, while his maternal grandparents built a large-scale farming operation.

Raul developed broad interests at an early age, ranging from literature to chemistry. He eventually decided to pursue a degree in Biology at the University of Porto in Portugal. It was during an extracurricular internship that he discovered his passion for research, which led him to complete a BSc thesis on the impact of pollutants on the ecological indicator species *Daphnia* spp. and *Lemna* spp., under the guidance of prof. Sara C. Antunes. Eager to expand his horizons, he participated in a European exchange program and spent a semester at the University of Umeå in Sweden, where he focused on Plant Biology and Microbiology. This experience confirmed his desire to continue his studies abroad, at the interface of these two fields. He eventually pursued a Master's degree in Plant Biotechnology at the University of Wageningen in the Netherlands, specializing in molecular phytopathology and conducting a thesis on how interspecific interactions between bacterial tomato endophytes changed their antimicrobial potential at the Department of Phytopathology. During his final MSc internship at the University of Wisconsin, Raul continued to explore the ecology of microorganisms by studying the assembly of microbiomes in agricultural soils under different crop rotation regimes, under the guidance of Professor Jean-Michel Ané. Throughout his studies, Raul was actively involved in causes that aimed to further the position of students within the faculty (NEBUP) and science communication (Science Café Wageningen, Letters with a Scientist). In his free time, he enjoys playing the saxophone in wind orchestras both in the Netherlands and Portugal.

After completing his Master's degree, Raul joined the Bill & Melinda Gates Foundation-funded PROMISE consortium at the Netherlands Institute of Ecology (NIOO-KNAW) under the supervision of Professors Jos Raaijmakers and Wietse de Boer, with daily guidance from prof. Francisco Dini-Andreote in the department of Microbial Ecology. During his PhD, he investigated the potential of volatile compounds produced by soil bacteria to suppress the germination of the parasitic plant *Striga hermonthica*, the results of which are presented in his thesis. Raul's aspiration is to continue to apply the knowledge and experience gained during his trajectory to facilitate the development and application of microbial solutions for sustainable crop protection.

List of publications

List of publications

Publications

1. **Masteling, R.**, de Boer, W., Raaijmakers, J.M., Garbeva, P., & Dini-Andreote, F. 2022. Microbial volatiles as mediators of eco-evolutionary dynamics. *Frontiers in Ecology and Evolution* **10**: 960198. **(chapter 7 of this thesis)**
2. Angulo, V. ^ϕ, Beriot, N. ^ϕ, Garcia-Hernández, E. ^ϕ, Li, E. ^ϕ, **Masteling, R.** ^ϕ, & Lau, J.A. 2022. Plant-microbe eco-evolutionary dynamics in a changing world. *New Phytologist* **234**: 1919-1928.
3. **Masteling, R.** ^ϕ, Voorhoeve, L. ^ϕ, IJsselmuiden, J., Dini-Andreote, F., de Boer, W., & Raaijmakers, J.M. 2020. DiSCount: computer vision for automated quantification of *Striga* seed germination. *Plant Methods* **16**: 60. **(chapter 3 of this thesis)**
4. **Masteling, R.**, Lombard, L., de Boer, W., Raaijmakers, J.M., & Dini-Andreote, F. 2019. Harnessing the microbiome to control plant parasitic weeds. *Current Opinion in Microbiology* **49**: 26-33. **(chapter 2 of this thesis)**
5. **Masteling, R.**, Castro, B., Antunes, S.C., & Nunes B. 2016. Whole-organism and biomarker endpoints in *Daphnia magna* show uncoupling of oxidative stress and endocrine disruption in phenolic derivatives. *Ecotoxicology and Environmental Safety* **134**: 64-71.

^ϕThese authors equally share first authorship.

Patents

1. **Masteling, R.**, de Boer, W., Raaijmakers, J.M.. Patent Application NL2028897, filling date 30.07.2021

PE&RC Training and Education Statement

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With the training and education activities listed below the PhD candidate has complied with the requirements set by the C.T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC) which comprises of a minimum total of 32 ECTS (= 22 weeks of activities)

Review of literature (6 ECTS)

- Harnessing the microbiome to control plant parasitic weeds

Writing of project proposal (4.5 ECTS)

- Microbial disruption of the signalling between sorghum and parasitic weed *Striga*

Post-graduate courses (4.1 ECTS)

- Frontiers in microbial ecology: eco-evolutionary dynamics of microbial-host interactions; PE&RC/SENSE (2018)
- Introduction to statistics in R; PE&RC (2019)
- Introduction to bioinformatics; EPS (2021)

Laboratory training and working visits (4.5 ECTS)

- Comparative genomics; AgBiome (2019)
- Plant-microbe interactions; UNC Chapel Hill (2019)
- Lab visit; Penn State University (2021)

Invited review of (unpublished) journal manuscript (2 ECTS)

- Frontiers in Bioengineering and Biotechnology: microbe mediated biocontrol (2020)
- Ecotoxicology and Environmental Safety: Sulfur volatile compounds and bacterial physiology (2020)

Deficiency, refresh, brush-up courses (0.3 ECTS)

- Introduction to LaTeX; PE&RC (2019)

Competence strengthening / skills courses (3 ECTS)

- Communication in science for PhDs; Leiden University (2018)
- Principles of ecological and evolutionary genomics; PE&RC (2018)
- Scientific conduct for PhDs; LGSC (2021)
- Launch your career; KNAW/ProActief (2022)
- On the way to a new job; KNAW/ProActief (2022)

PE&RC Annual meetings, seminars or weekends (2.4 ECTS)

- PE&RC Day (2018)
- PE&RC Weekends (2018, 2020, 2021)

Discussion groups / local seminars or scientific meetings (9 ECTS)

- NIOO-wide seminars (2018-2022)
- NIOO-coding club (2019-2020)
- ME PhD group meetings (2019-2022)

International symposia, workshops and conferences (13.1 ECTS)

- EPS Theme 2 symposium (2019)
- Scientific advisory board AgBiome (2019)
- BAGECO15: Bacterial genomics and ecology (2019)
- World congress on parasitic plants (2019)
- Nature conferences: Harnessing the plant microbiome (2021)
- Plant BioProtech (2022)
- miCROPe international symposium (2022)

Lecturing / supervision of practicals / tutorials (1.5 ECTS)

- Ecological aspects of bio-interactions (2019)

Supervision of MSc students (6 ECTS)

- Volatile-mediated suppression of *Striga hermonthica*
- Comparative genomics of *Striga* suppressive *Janthinobacterium*