Carl McCombe

Website: https://carl-mccombe.github.io
Email: carl.mccombe@anu.edu.au
ORCID: https://orcid.org/0000-0001-9347-8879

Brief profile

A Ph.D. candidate in the Research School of Biology at The Australian National University. I am a molecular biologist/biochemist investigating the functions of proteins involved in plant-microbe interactions.

Education

The Australian National University, Australia — Expected July 2024
Ph.D. Research School of Biology
Advisor: Simon J. Williams

The Australian National University, Australia — 2019
B.S. with First Class Honours in Biology. GPA: 7.00/7.00
Awarded University Medal

Flinders University, Australia — 2016 - 2018
B.S (Biotechnology) GPA: 6.95/7.00

Publications

- **CL McCombe**, A Wegner, CS Zamora, F Casanova, S Aditya, JR Greenwood, L Wirtz, S Paula, E England, S Shang, DJ Ericsson, E Oliveira-Garcia, SJ Williams, U Schaffrath (2023). "Plant pathogenic fungi hijack phosphate starvation signaling with conserved enzymatic effectors" *bioRxiv* *https://doi.org/10.1101/2023.11.14.566975*
- **CL McCombe**, AM Catanzariti, JR Greenwood, AM Desai, MA Outram, DS Yu, DJ Ericsson, SE Brenner, PN Dodds, B Kobe, DA Jones, SJ Williams (2023). "A rust-fungus Nudix hydrolase effector decaps mRNA *in vitro* and interferes with plant immune pathways" *New Phytologist* *https://doi.org/10.1111/nph.18727*
    - Commentary by Mark J. Banfield
- DS Yu, MA Outram, A Smith, **CL McCombe**, PB Khambalkar, SA Rima, X Sun, L Ma, DJ Ericsson, DA Jones, SJ Williams (2023). "The structural repertoire of *Fusarium oxysporum f. sp. lycopersici* effectors revealed by experimental and computational studies" *eLife* *https://doi.org/10.7554/eLife.89280.1*
- **CL McCombe**, JR Greenwood, PS Solomon, SJ Williams (2022). "Molecular plant immunity against biotrophic, hemibiotrophic, and necrotrophic fungi." *Essays in Biochemistry* *https://doi.org/10.1042/EBC20210073*

Honors and Awards

Hirota Naora award – Best presentation at the RSB HDR conference — 2022
CPG award presentation at Combio – Australia's largest biology conference — 2022
Runner-up best student presentation at East Coast Protein Meeting — 2022
Postgraduate research award – Australian Institute of Nuclear Science and Engineering — 2020
Australian Government research training program stipend — 2020 - 2023
University medal – The Australian National University — 2019

RSB director's prize in Honours – The Australian National University 2019

Honours scholarship – Australian Institute of Nuclear Science and Engineering 2019

Summer research scholarship – The Australian National University 2018

Summer research award – Flinders University 2017

Chancellor's letter of commendation – Flinders University 2016/2017/2018

Research experience

The Australian National University

PhD candidate – Williams Lab 2020 - Present

- Designed and executed experiments to investigate the enzymatic activity of uncharacterized proteins involved in plant-microbe interactions both *in vitro* and *in planta*
- Assisted in the training of new students, including a primary supervisor role for four semester-long undergraduate student projects and an Honours student project
- Disseminated experimental results in research publications and conference presentations
- Helped manage lab ordering, maintenance and organization

The Australian National University

Technical assistant – COVID-19 genomic sequencing team 2021

- I was a member of the team responsible for COVID-19 genomic surveillance in the Australian Capital Territory during 2021. I received cDNA samples and prepared multiplexed libraries for Nanopore sequencing.

The Australian National University

Honours student – Williams Lab 2019

- A one-year research project aiming to determine the function of AvrM14, a protein involved in the pathogenesis of flax rust. This project had a focus on structural biology and linking protein structure to biochemical function.

Flinders University

Research assistant – Day Lab 2018

- Worked both independently and in a team completing various general molecular biology techniques to aid in research projects

Teaching experience

The Australian National University

Biochemistry and human nutrition (BIOL2171) laboratory demonstrating 2021 - 2023

- Teaching and supervising students in biochemistry lab classes
- Marking of laboratory reports

Biochemistry and human nutrition (BIOL2171) Honours Pathway Option Tutor 2023

- Directing advanced undergraduate workshops for students wishing to extend their learning
- Marking and providing feedback on student presentations

Advanced studies course (SCNC2101) research project design and lab supervision 2020, 2022/23/24

- Designing and supervising semester-long undergraduate research projects for second- and third-year undergraduate students

General microbiology (BIOL2142) laboratory demonstrating

- Teaching and supervising students in microbiology lab classes
- Marking of scientific reports

Molecular gene technology (BIOL2162) workshop tutor 2021/22

- Providing guidance to, and teaching, students who were completing online zoom workshops covering a variety of molecular biology research techniques

Supervisory experience

For all students listed below I designed their projects and directly supervised their laboratory work.

Eleanor England, undergraduate student 2020

Project title: Identifying inositol pyrophosphate hydrolase effectors from pathogenic fungi

Elly's research contributed to https://doi.org/10.1101/2023.11.14.566975

Sascha Shang, undergraduate student 2022

Project title: Determining the function of rice blast effectors

Sascha's research contributed to https://doi.org/10.1101/2023.11.14.566975

Riley Furbank, undergraduate student 2023

Project title: *In silco* protein design to manipulate plant-pathogen interactions

Joy Peter, undergraduate student 2023/24

Project title: Biophysical characterization of *de novo* designed protein-based enzyme inhibitors

Ben Silke, Honours student 2024

Project title: Disarming plant pathogens with nanobodies

Professional service

Plant Services Team – Weekend watering 2023/24

On certain weekends and public holidays, I maintain the diverse plants used in academic research at the Australian National University

Conference Chair

2022 ANU ECR conference

2023 Stromlo plant pathology conference

Journal reviewer

Molecular Plant-Microbe Interactions	2023
Molecular Plant Pathology	2023, 2024
Journal of Experimental Botany	2021, 2022

Research skills

A non-exhaustive list of the research techniques/tools used during my research career.

- Recombinant protein expression and purification
- Fast protein liquid chromatography (FPLC) using AKTA systems
- X-ray crystallography and structural biology
- Agroinfiltration of *N. benthamiana* for transient gene expression
- Plant RNA extraction, purification, RT-qPCR, and RNA-sequencing
- Nanopore library preparation
- Python programming language (especially for organizing large datasets and data visualization)
- Various general molecular biology techniques (e.g., western blotting, molecular cloning, enzyme assays etc.)