

Carl McCombe

Website: <https://carl-mccombe.github.io>
Email: carl.l.mccombe@gmail.com
ORCID: <https://orcid.org/0000-0001-9347-8879>

Academic History

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| California Institute of Technology (Caltech) Postdoctoral Scholar Chemistry and Chemical Engineering <i>Advisor:</i> Gözde S. Demirel | <u>2025 - Present</u> |
| The Australian National University, Australia Ph.D. Research School of Biology <i>Advisor:</i> Simon J. Williams | <u>2020 - 2024</u> |
| The Australian National University, Australia B.S. with First Class Honours in Biology. GPA: 7.00/7.00 Awarded University Medal | <u>2019</u> |
| Flinders University, Australia B.S (Biotechnology) GPA: 6.95/7.00 | <u>2016 - 2018</u> |

Publications

- **CL McCombe**, A Wegner, L Wirtz, CS Zamora, F Casanova, S Aditya, JR Greenwood, S Paula, E England, S Shang, DJ Ericsson, E Oliveira-Garcia, SJ Williams, U Schaffrath (2025). “Plant pathogenic fungi hijack phosphate signaling with conserved enzymatic effectors” *Science* <https://doi.org/10.1126/science.adl5764>
 - [Perspective](#) by Caroline Gutjahr published in *Science*
 - [Research highlight](#) by Andrea Du Toit published in *Nature Reviews Microbiology*
- DS Yu, MA Outram, A Smith, **CL McCombe**, PB Khambalkar, SA Rima, X Sun, L Ma, DJ Ericsson, DA Jones, SJ Williams (2024). “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**, 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 published in *New Phytologist*
- **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

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| Vice-Chancellor’s HDR Travel Grant (\$1500 AUD) | <u>2023</u> |
| AINSE Travel Award (\$1000 AUD) | <u>2023</u> |
| IS-MPMI Shimamoto Travel Award (\$2000 USD) | <u>2023</u> |
| Hirota Naora award – Best presentation at an ANU conference | <u>2022</u> |
| CPG award presentation at Combio – Invited speaker at Australia’s largest biology conference | <u>2022</u> |
| Runner-up best student presentation at East Coast Protein Meeting | <u>2022</u> |
| AINSE Postgraduate research award (\$25000 AUD) | <u>2020 - 2023</u> |

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| Australian Government research training program stipend (\$90000 AUD) | <u>2020 - 2023</u> |
| University medal – The Australian National University | <u>2019</u> |
| RSB director’s prize in Honours – The Australian National University | <u>2019</u> |
| AINSE Honours scholarship (\$5000 AUD) | <u>2019</u> |
| Summer research scholarship – The Australian National University | <u>2018</u> |
| Summer research award – Flinders University | <u>2017</u> |
| Chancellor’s letter of commendation – Flinders University | <u>2016/2017/2018</u> |

Research experience

The Australian National University

Postdoctoral Fellow – [Jones & Williams Labs](#) 2024

- Following submission of my PhD thesis I worked as a Postdoctoral Fellow on an Australian Research Council Grant jointly held by Professor’s David Jones and Simon Williams
- Along with my Honours student Benjamin Silke, we developed nanobodies and *de novo* designed protein-binders to improve plant disease resistance

The Australian National University

PhD candidate – [Williams Lab](#) 2020 - 2024

- Functionally characterised secreted enzymes important for various plant diseases, culminating in two major first author papers and a review article
- Assisted in the training of new students, including a primary supervisor role for four semester-long undergraduate student projects

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 McCombe *et al.*, (2025) - <https://doi.org/10.1126/science.adl5764>

Sascha Shang, undergraduate student 2022

Project title: Determining the function of rice blast effectors

Sascha's research contributed to McCombe *et al.*, (2025) - <https://doi.org/10.1126/science.adl5764>

Riley Furbank, undergraduate student 2023

Project title: *In silico* 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

Ben graduated with First-Class Honours and is currently completing his PhD

Professional service

Plant Services Team – Weekend watering 2023/24

On weekends and public holidays, our team maintained 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

Plant Physiology 2025

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
- Isothermal titration calorimetry (ITC) for protein-protein and protein-ligand interactions
- 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.)