Kevin Ao, Ph.D.

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Profile

- Accomplished research scientist with a diverse skill set and extensive experience in executing research projects
- 10+ years expertise in molecular biology and microbiology, with emphasis on plants and plant-microbe interactions

Scientific expertise:	Molecular signaling pathways, plant immunity, plant-microbe interactions, CRISPR, synbio
Technical expertise:	Molecular biology, genetics, microbiology, biochemistry, bioinformatics (R/Unix), cell biology
Other proficiencies:	Problem solving, grant/proposal writing, research innovation, mentorship, literature review
Research interests:	Plant biotechnology, crop improvement, sustainable agriculture, agritech, entrepreneurship

Education

2015 – 2022 **Doctor of Philosophy, Botany**
Michael Smith Laboratories/Department of Botany, University of British Columbia, Canada
Dissertation: Characterization of two regulators in plant immune receptor-mediated defense (link)
Principal investigator: Dr. Xin Li (about)

2010 – 2015 **Honours Bachelor of Science with distinction (Co-op), Biotechnology, Minor in Biology**
University of British Columbia, Vancouver, BC, Canada (about)

2011 – 2013 **Diploma of Technology with distinction (Co-op), Biotechnology** (about)
British Columbia Institute of Technology, Burnaby, BC, Canada

Research Experience

08.2023 – Present **Department of Chemical and Biomolecular Engineering, University of California, Berkeley**
Postdoctoral Researcher – lab of Dr. Markita Landry (about)

- Development of nanomaterials for transient plant transformation

01.2023 – 08.2023 **Department of Botany/Michael Smith Laboratories, University of British Columbia, Canada**
Research Scientist (Contract) – lab of Dr. Xin Li (about)

- Wrote bioinformatics pipeline to automate candidate gene discovery from NGS screen data

09.2022 – 12.2022 **Lab2Market market research program** (about)
Entrepreneurial lead

- Explored the market potential for a novel bioherbicide product developed in the lab.
- Fostered relationships with farmers, agronomists, government/business professionals
- Connected with various businesses in the biotech/synthetic biology space

05.2015 – 10.2022 **Department of Botany/Michael Smith Laboratories, University of British Columbia, Canada**
NSERC-funded graduate student – lab of Dr. Xin Li (about)

- Characterized two regulators in plant immune receptor-mediated defense using genetics, CRISPR, protein biochemistry, pathogen infections, confocal microscopy, mass spectrometry, phylogenetic analyses…etc.
- Wrote bioinformatic scripts to analyze NGS data, perform statistic/data analysis, and generate figures to uncover gene expression networks controlled by transcription factors
- Designed, prepared protocols for, and successfully executed a CRISPR-based genetic deletion screen to identify TRAF proteins involved in plant immunity
- Employed phylogenetic analysis to infer relationships between genes and gene families
- Managed multiple research projects simultaneously
- Communicated results in written and oral formats to a variety of audiences
- Applied diverse molecular biology techniques to test hypotheses and answer questions
- Independently designed, constructed, and tested plant expression constructs
- Identified suitable techniques to address hypotheses & tested/optimized protocols/SOPs
- Conceived of new projects and initiated experiments based on ideas and literature review
- Actively followed latest research findings and trends

05.2019 – 08.2019 **Molecular Biology of Plant-Microbe Interactions, University of Göttingen, Germany**
Visiting student – lab of Dr. Marcel Wiermer (about)
- Characterized subcellular (co)-localization of immune proteins using confocal microscopy

01.2016 – 03.2016 **Michael Smith Laboratories, University of British Columbia, Canada**
Graduate rotation student – lab of Dr. Leonard Foster (about)
- Identified potential peptide biomarkers for acute spinal cord injury using bioinformatics

09.2015 – 12.2015 **Department of Cellular and Physiological Sciences, University of British Columbia,Canada**
Graduate rotation student – lab of Dr. Chris Loewen (about)
- Investigated function of a putative lipid transporter in yeast using a high-throughput array screen to identify synthetic-dosage-lethal (SDL) genetic pathway relationships

09.2014 – 12.2014 **Department of Microbiology and Immunology, University of British Columbia, Canada**
Honours thesis student – lab of Dr. James Kronstad (about)
- Created gene deletion mutants in *Ustilago maydis* using overlap extension PCR and biolistic transformation to study the putative virulence functions of select genes.

01.2014 – 08.2014 **Protein Purification Department, iProgen Biotech Inc., Richmond, Canada** (about)
NSERC-funded co-op research assistant – advised by Dr. Paula Lario
- Produced and purified proprietary proteins in *E. coli* & generated QC data

05.2013 – 08.2013 **National Research Council, Saskatoon, Canada** (about)
Research assistant – lab of Dr. Pierre Fobert
- Genetically fine mapped a wheat locus responsible for resistance against wheat stem rust

05.2013 – 08.2013 **Department of Botany/Michael Smith Laboratories, University of British Columbia, Canada**
NSERC- and GSAT-funded co-op research assistant – lab of Dr. Joerg Bohlmann (about)
- Characterized the enzyme kinetics of Pacific redcedar deoxyxylulose-5-phosphate synthase

Leadership, Teaching, and Mentorship Experience

09.2021 – 08.2023 **Mentor and advisor, UBC iGEM (International Genetically Engineered Machine)** (about)
- Evaluated synthetic biology project ideas and provided guidance, suggestions, and critique

09.2021 – 04.2022 **Undergraduate work-learn student mentorship (1 student)**
- Taught technical lab skills relevant for studying plant immunity.

01.2019 – 03.2019 **Mitacs visiting graduate student mentorship (1 student)**
- Mentored a visiting MSc. student from Korea in Arabidopsis genetics techniques

09.2018 – 05.2019
05.2018 – 08.2019 **Undergraduate work-learn student, undergrad volunteer mentorship (2 students)**
- Taught technical lab skills relevant for studying plant immunity.
- Guided an undergraduate student to complete an independent project in plant genetics

09.2017 – 04.2018 **Teaching Assistant, BIOL341 - Introductory Molecular Biology Laboratory** (about)
- Taught a technical molecular biology/cloning lab to over 96 students over two semesters.

05.2017 – 08.2017 **Summer undergraduate student mentorship (2 students)**
- Mentored two undergraduate students to complete a large-scale reverse genetic screen.

04.2017 – 08.2017 **German visiting graduate student mentorship (1 student)**
- Mentored a visiting PhD student from Germany during their 5 month stay in Vancouver.

09.2012 – 08.2013 **Vice President, UBC-BCIT Biotechnology Club** (about)
- Led executive team to organize academic, social, and fundraising events

09.2012 – 08.2013 **Biotech. Program Rep., UBC Microbiology and Immunology Student Association** (about)
- Planned and led academic and social events benefiting microbiology students

Research Contributions

4 first or co-first author published peer-reviewed original research articles. 2 first or co-first author published peer-reviewed review articles. ▌ denotes (co-)first author publications. * denotes equal contribution.

Peer-reviewed original research

1. **Ao, K.**, Rohmann, P., Huang, S., Li, L., Lipka, V., Chen, S., Wiermer, M., and Li, X. (2023). TRAF domain protein TC1b is required for the defense responses mediated by plant NLR SNC1. *The Plant Journal*. (link)

2. Xu, Y., **Ao, K.**, Tian, L., Qiu, Y., Huang, X., Liu, X., Hoy, R., Zhang, Y., Rashid, K. Y., Xia, S., and Li, X. (2022). A forward genetic screen in Sclerotinia Sclerotiorum revealed the transcriptional regulation of its sclerotial melanization pathway. *Molecular Plant-Microbe Interactions, 35*:244–256. (link)

3. **Ao, K.**, Tong, M., Li, L., Lüdke, D., Lipka, V., Chen, S., Wiermer, M., Li, X. (2021) $SCF^{SNIPER7}$ controls protein turnover of unfoldase CDC48A to promote plant immunity. *New Phytologist*, *229*:2795-2811. (link)

4. Tian, H.*, Wu, Z.*, Chen, S.*, **Ao, K.**, Huang, W., Yaghmaiean, H., Sun, T., Xu, F., Zhang, Y., Wang, S., Li, X., Zhang, Y. (2021) Activation of TIR signalling boosts pattern-triggered immunity. *Nature*, *598*:500-503. (link)

5. Lian, K.*, Gao, F.*, Sun, T.*, van Wersch, R., **Ao, K.**, Kong, Q., Nitta, Y., Wu, D., Krysan, P., Zhang, Y. (2018) MKK6 functions in two parallel MAP kinase cascades in immune signaling. *Plant Physiology, 178*:1284-1295.(link)

6. Ding, Y.*, Sun, T.*, **Ao, K.**, Peng, Y., Zhang, Y., Li, X., Zhang, Y. (2018) Opposite roles of salicylic acid receptors NPR1 and NPR3/4 in transcriptional regulation of plant immunity. *Cell*, *173*:1454-1467. (link)

7. Dong, O.*, **Ao, K.***, Xu, F.*, Johnson, K., Wu, Y., Li, L., Xia, S., Liu, Y., Huang, Y., Rodriguez, E., Chen, X., Chen, S., Zhang, Y., Petersen, M., Li, X. (2018) Individual components of paired typical NLR immune receptors are regulated by distinct E3 ligases. *Nature Plants, 4*:699-710. (link)

8. Huang, S., Chen, X., Zhong, X., Li, M., **Ao, K**., Huang, J., and Li, X. (2016) Plant TRAF Proteins Regulate NLR Immune Receptor Turnover. *Cell Host & Microbe*, *19*:204-215. (link)

9. Copeland, C.*, **Ao, K.***, Huang, Y., Tong, M., Li, X. (2016) The Evolutionarily Conserved E3 Ubiquitin Ligase AtCHIP Contributes to Plant Immunity. *Frontiers in Plant Science, 7*:309. (link)

10. Liu, J.*, Yang, H.*, Bao, F., **Ao, K**., Zhang, X., Zhang, Y., Yang, S. (2015) IBR5 Modulates Temperature-Dependent, R Protein CHS3-Mediated Defense Responses in Arabidopsis. *PLoS Genetics, 11*:e1005584. (link)

Peer-reviewed review articles

1. **Ao, K.**, Li, X. (2022). Indirect recognition of pathogen effectors by NLRs. *Essays in Biochemistry, 66*:485-500.(link)

2. Liu, X.*, **Ao, K.***, Yao, J., Zhang, Y., Li, X. (2021) Engineering plant disease resistance against biotrophic pathogens. *Current Opinion in Plant Biology*, *60*:10198. (link)

3. He, Z.*, Huang, T.*, **Ao, K.**, Yan, X., Huang, Y. (2017) Sumoylation, phosphorylation, and acetylation fine-tune the turnover of plant immunity components mediated by ubiquitination. *Frontiers in Plant Science, 8*:1682. (link)

Other publications

1. **Ao, K.**, Zhang, Y. (2021). From blooms to brooms. *Trends in Microbiology*, *30*:3-5. Invited non-reviewed commentary. (link)

Media Appearances

1. Isaacs, J. (2016, October) CRISPR-CAS9: A promising tool for plant breeding. *Top Crop Manager West, 42*(11), 10-11. (link)

Conferences, meetings, retreats, and symposiums

Oral presentations

1. **Plenary Speaker. Ao, K.**, et al. Helper NLRs in plant immunity. Plant Biology 2022 – American Society of Plant Biologists/Canadian Society of Plant Biologists. Portland, OR (July 2022). (about)

2. Speaker. **Ao, K.**, Rohmann, P., Li, L., Lipka, V., Chen, S., Wiermer, M., and Li, X. TRAF domain protein TC1b is required for the autoimmunity of *snc1*. PRoTECT (Plant Responses to Eliminate Critical Threats) Annual Retreat. Vancouver, BC (August 2022). (about)

3. Speaker. **Ao, K.**, Rohmann, P., Li, L., Lipka, V., Chen, S., Wiermer, M., and Li, X. TC1b – a TRAF domain protein that acts as a positive regulator of plant immunity. PRoTECT (Plant Responses to Eliminate Critical Threats) Seminar Series. Virtual (December 2021). (about)

4. **Science outreach presenter. Ao, K.**, Sun, S., and Behar, H. Science of agriculture, food security, and environmental sustainability. Let's Talk Science Climate Change Symposium. Virtual (June 2021). (about)

5. Speaker. **Ao, K.**, Rohmann, P., Li, L., Lipka, V., Chen, S., Wiermer, M., and Li, X. TC1b – a TRAF domain protein that acts as a positive regulator of plant immunity. PRoTECT (Plant Responses to Eliminate Critical Threats) Annual Retreat. Virtual (August 2021). (about)

6. **Selected talk for grant review. Ao, K.**, Tong, M., Li, L., Lüdke, D., Lipka, V., Chen, S., Wiermer, M., Li, X. Protein homeostasis of the conserved unfoldase CDC48A is regulated by $SCF^{SNIPER7}$. PRoTECT (Plant Responses to Eliminate Critical Threats) Annual Retreat and Grant Review. Göttingen, Germany (February 2020). (about)

7. Speaker. **Ao, K.**, Tong, M., Li, L., Lüdke, D., Lipka, V., Chen, S., Wiermer, M., Li, X. CDC48A protein level is regulated by E3 ligase $SCF^{SNIPER7}$ complex. PRoTECT (Plant Responses to Eliminate Critical Threats) Annual Retreat. Summerland, BC (August 2019). (about)

8. Speaker. **Ao, K.**, Tong, M., Li, L., Lüdke, D., Lipka, V., Chen, S., Wiermer, M., Li, X. CDC48A protein level is regulated by E3 ligase $SCF^{SNIPER7}$ complex. PRoTECT (Plant Responses to Eliminate Critical Threats) Seminar Series. Vancouver, BC (March 2019). (about)

9. **Selected talk. Ao, K.**, Huang, S., Huang, J., and Li, X. Elucidating the immune functions of plant TRAF domain proteins using CRISPR. CSPB/SCBV – CSHS/SCSG Annual Meeting – Joint Conference. Vancouver, BC (July 2017). (about)

10. **Selected talk. Ao, K.**, Huang, S., Huang, J., and Li, X. A reverse genetic screen for immune regulators in *Arabidopsis thaliana* using CRISPR. Botany Graduate Student Association Symposium 2017. Vancouver, BC (April 2017).

11. Speaker. **Ao, K.**, Huang, S., Huang, J., and Li, X. Elucidating the putative immune function of *Arabidopsis thaliana* TRAF domain proteins using a targeted CRISPR screen. PRoTECT (Plant Responses to Eliminate Critical Threats) Annual Retreat. Vancouver, BC (August 2016).

Poster presentations

1. **Ao, K.**, Rohmann, P., Li, L., Lipka, V., Chen, S., Wiermer, M., and Li, X. TRAF domain protein TC1b is required for the defense responses mediated by plant immune receptor SNC1. Plant Biology 2022 – American Society of Plant Biologists/Canadian Society of Plant Biologists. Portland, OR (July 2022). (about)

2. **Ao, K.**, Tong, M., Li, L., Lüdke, D., Lipka, V., Chen, S., Wiermer, M., Li, X. Protein homeostasis of the unfoldase CDC48A is controlled by $SCF^{SNIPER7}$ E3-ligase complex. PRoTECT (Plant Responses to Eliminate Critical Threats) Annual Retreat and Grant Review. Göttingen, Germany (February 2020). (about)

3. **Ao, K.**, Tong, M., Li, L., Chen, S., Li, X. CDC48A protein level is regulated by $SCF^{SNIPER7}$. International Society for Molecular Plant-Microbe Interactions International Congress. Glasgow, Scotland (July 2019). (about)

Honours, Awards, and Scholarships

2019	**NSERC Canada Graduate Scholarship - Michael Smith Foreign Study Supplement** ($6000) (about)
2018 – 2021	**NSERC Alexander Graham Bell Canada Graduate Scholarship – Doctoral** ($35,000/year) (about)
2018 – 2022	**UBC Four Year Fellowship** ($18,200/year) (about)
2016 – 2017	**NSERC Canadian Graduate Scholarship Master's Award** ($17,500/year) (about)
2015 – 2017	**Faculty of Science Graduate Award** ($4500/year) (about)
2015	**NSERC Undergraduate Student Research Award** ($4500) (about)
2014	**Adam F Szczawinski Prize in Botany** ($75) (about)
2014	**NSERC Industrial Undergraduate Student Research Award** ($9000) (about)
2012	**The Enns Family Award in Biotechnology** ($750)
2012	**NSERC Undergraduate Student Research Award** ($4500) (about)
2012	**Genome Science and Technology Summer Studentship** ($100)
2011	**BCIT Alumni Association Entrance Award** ($1500) (about)
2010	**UBC President's Entrance Award** ($2500) (about)
2010	**BC Ministry of Education Provincial Scholarship Award** ($1000) (about)